Inorganic Fertilization of Walleye (*Stizostedion vitreum*) Hatchery Ponds

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by

Roderick J. Middleton

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Roderick J. Middleton, M.S.
Morehead State University, 1998

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Some Ohio hatcheries have experienced increased fish yields and reduced anoxia in rearing ponds fertilized with inorganic fertilizer, when compared to those fertilized with organic fertilizer. At Minor E. Clark Fish Hatchery in Morehead, Kentucky, three 0.41 hectacre hatchery ponds were fertilized using traditional hatchery methods (control), and three with inorganic nutrients (experimental). Traditional fertilization included additions of chopped hay, soybean meal, alfalfa meal, potash, and 9-18-9 inorganic liquid fertilizer. Experimental fertilizer applications included 28-0-0 liquid fertilizer and phosphoric acid. Ponds were monitored weekly for nutrient concentrations, primary production, and plankton populations. Experimental fertilization resulted in pond inorganic N (ammonium and nitrate) mean concentrations of 213 $\mu g\ L^{-1}$ and SRP mean concentrations of 9.3 $\mu g\ L^{-1}$; while control fertilization resulted in pond inorganic N (ammonium and nitrate) mean concentrations of 201 $\mu g\ L^{-1}$ and SRP mean concentrations of 6.6 $\mu g\ L^{-1}$. Secchi Depths were significantly higher within the experimental ponds compared to the control ponds (1.15 and 0.72 meters respectively). Dissolved oxygen concentrations

were also significantly higher within the experimental ponds compared to the control ponds with means of 11.21 mg L^{-1} and 7.91 mg L^{-1} respectively. Survival in control ponds averaged 87% (78 kg fish ha^{-1}); while the experimental ponds averaged 37% survival (36 kg fish ha^{-1}). It may be that inorganic fertilization is ineffective in southern hatcheries; however, exceptionally cold spring weather may have affected the results.

Accepted by: [illegible], Chair

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Howard L. Sitser

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1.0 Introduction

Kentucky is dependent upon fish hatcheries to supply large numbers of game fish for stocking the Commonwealth's reservoirs each year because Kentucky lakes lack sufficient littoral habitat for spawning and growing game fish. Additionally, due to their steeply sloping banks, construction of these reservoirs has permanently destroyed many of the natural spawning areas for native fish populations and low nutrient concentrations keep reservoirs fish production low (Ney and Yurk 1989).

Traditional game fish aquaculture relies upon the application of large quantities of fertilizer. The application of fertilizers to hatchery ponds increases fish production through bottom-up nutrient manipulation (as discussed in McQueen et al. 1986). Commonly, organic fertilizers such as chopped hay, soybean meal, alfalfa meal, and rice bran are used in traditional aquaculture. Organic fertilizers have several draw backs: 1) they contain varied and unknown nutrient concentrations, 2) they are not biologically available for days because they must first decompose, 3) they increase anoxia as they decompose -- often resulting in a need for expensive supplemental aeration, 4) they must be added two to three times per week, requiring significant human power and added expense; and 5) they can result in filamentous algae production which provides low quality food for zooplankton the fish larval require. To alleviate these problems, researchers began looking at using different types of inorganic fertilizers in hatchery ponds (Geiger et al. 1985; Fox et al. 1989, 1992; Qin and Culver 1992; Myers et al. 1996). Included with an inorganic fertilization program, is monitoring nutrient inputs and their exits in order to maximize fish production.

The goal of this research was to determine how effective an inorganic fertilization program would be at Minor E. Clark Fish Hatchery (MCFH) in Eastern Kentucky. Historically, studies have looked at increasing fish harvest at hatcheries having poor production. There are few, if any studies looking at improving production at highly productive hatcheries. MCFH has a history of high fish production. If successful, this high N:P ratio inorganic regime could possibly replace the current fertilization method being used at MCFH, a combination of organic and inorganic fertilizers, and solve problems (such as anoxia and filamentous algae) typical of the current fertilization program.

Over the past ten years limnologists have learned a great deal about the interactions of energy flows from primary producers (phytoplankton) to predatory fish (game fish) within the lake environment (Carpenter and Kitchell 1988). This research will try to determine if some of these lake concepts can be applied to help improve hatchery fish production. The objective of this study was to fertilize three ponds using traditional hatchery methods, and then compare the resulting nutrient levels, plankton diversity, fish production, and primary production to three ponds fertilized using only inorganic fertilizers.

2.0 Literature Review

Like many other states, the Commonwealth of Kentucky has become dependent upon the propagation of game fish to support the sport fishing needs within the state's reservoirs (Lasker 1987). These reservoirs are not conducive for producing large numbers of game fish and require supplemental stockings to offset low natural reproduction caused mostly by a loss of natural spawning habitats (Bardach 1976; Culver et al. 1993). In order to increase the numbers of fish within these reservoirs, most states have developed stocking programs that demand millions of fish per year (Bardach 1976; Conover 1986; Lasker 1987). Fish aquaculture is dependent upon the use of large amounts of organic fertilizers. Two principle disadvantages associated with the application of organic fertilizers are 1) that they can result in high biological oxygen demand (Schroeder 1978; Loadman et al. 1989) and 2) they promote the growth of blue-green algae (Mathias and Li 1982). High biological oxygen demand can lead to fish kills (Schroeder 1978; Loadman et al. 1989), and blue-green algae are not an edible food source for most zooplankton species (Mathias and Li 1982). Both of these factors will lead to reduced fish production.

Hatchery ponds fall under bottom-up nutrient manipulation: the addition of fertilizer increases nutrient concentrations, which leads to increases in production throughout the food web (McQueen et al. 1986). Aquaculture professionals generally think that high phytoplankton productivity will result in high fish productivity, but current research has suggested that plankton-nutrient-fish interactions are much more complex than previously thought (Qin et al. 1995).

Since the early 1960s, limnologists have known that the main limiting factor of primary productivity within most freshwater habitats is phosphorus (Schindler 1977). However, only recently has the relationship between nitrogen and phosphorus on the plankton community structure been researched. Smith (1983) and Infante and Abella (1985) suggested that high N: P ratios would favor green algae, while low N: P ratios favor blue-green algae. Under high P concentrations most phytoplankton suffer a secondary N limitation, which N -fixing blue-green algae (cyanobacteria) overcome. These blooms are undesirable because they reduce light penetration and are an undesirable and/or toxic food source.

Field studies have found that manipulation of N:P ratios in hatchery ponds alters the types of algae found within them (Helal and Culver 1991). A lower N:P ratio and the addition of large amounts of fertilizer frequently favor production of blue-green algae and filamentous green algae. These species of algae produce an inefficient food chain that interferes with fish survival and growth rates (Infante and Abella 1985; Culver et al. 1993). A high N:P ratio favors the production of small green algae (Smith 1983) which are consumed by zooplankton (Rhee 1978; Helal and Culver 1991; Culver 1991) and provide a better food source for larval walleye (Qin and Culver 1992).

Walleye, *Stizostedion vitreum*, are propagated in large numbers by many state and federal hatcheries (Conover 1986). Walleye have been cultured for stocking purposes for many years, but there is high variability in survival rates from the larval to juvenile stage within hatchery ponds – ranging from 0% to 75% (Hile 1937; Li and Mathias 1982). Many studies have shown that fish production can be improved by pond fertilization (Smith and Moyle 1943; Dobie 1956; Geiger 1983; Qin and Culver 1992). There also have been studies on how to increase survival from larval to juvenile fish by using a variety of fertilization regimes (Fox et al. 1989, 1992; Qin and Culver 1992; Culver et al. 1993).

Fox et al. (1992) looked at supplementing organic fertilizers with the addition of inorganic fertilizers to increase fish growth rates and total fish weight within hatchery ponds. They determined that the walleye in ponds that received inorganic fertilizer along with organic grew faster and weighed almost twice as much as those within the control ponds that received only organic fertilizer.

Culver (1991) studied a variety of fertilizer regimes including inorganic only programs as well as a mixture of organic and inorganic fertilizer regime. There were no significant differences in the production of total zooplankton and phytoplankton; however, overall survival within ponds that received organic and inorganic fertilizer was 2.5 %, compared to 77.9% in ponds that received only inorganic fertilizer (Qin and Culver 1992). They suspected that the high mortality within ponds that received both inorganic and organic fertilizer was caused by low dissolved oxygen. Fish kills caused by low dissolved oxygen are inherent when using organic fertilizers (Hoff and

Chiltenden 1969; Schroeder 1978; Loadman et al. 1989). Culver (1991) and Qin and Culver (1992) concluded that a high N to P ratio (20:1) of inorganic fertilizer is best for rearing walleye because this ratio has the ability to maintain high dissolved oxygen levels and eliminate bust ponds (ponds with survival of less than ten percent). Based upon this, Culver (1993) revised his fertilization techniques at three Ohio hatcheries. Inorganic nitrogen (NH_4 and NO_3) and phosphate concentrations were raised weekly to 0.6 mg L^{-1} and 0.03 mg L^{-1} respectively to obtain the N:P ratio of 20:1-- which provided the optimal results.

3.0 Materials and Methods

3.1 Study Site Description

Minor E. Clark Fish Hatchery (MCFH) in Morehead, Kentucky, U.S.A. was constructed in 1973 concurrent with Cave Run Lake Reservoir by the United States Army Corps of Engineers. Cave Run Lake serves as a multi-purpose reservoir, providing flood control, recreation, and drinking water for the Morehead, Kentucky area. Cave Run Lake also serves as the water supply for MCFH.

MCFH is one of the largest state-owned, warm-water fish hatcheries in the United States, and the largest state operated hatchery in Kentucky. The hatchery is located in the tailwater area of Cave Run Lake south of Farmers, Kentucky and covers 122 ha of the Licking River alluvial flood plain. There are 111 rearing and brood ponds covering approximately 50.3 surface water ha, including eighty-two 0.41 ha ponds. About one quarter of which are used to rear walleye (Kentucky Department of Fish and Wildlife Resources 1976).

The hatchery water is supplied by gravity flow from Cave Run Lake. Water can be drawn from three separate levels within the lake to allow for partial control of water temperature and dissolved oxygen. The inflow pipe of each pond is covered with a 0.51mm mesh saran bag, which prevents the introduction of fish from Cave Run Lake but allows phytoplankton and zooplankton to pass through to the ponds. Each pond has water inflow pipes at both ends to allow for quick filling of the pond if necessary.

The hatchery ponds have sloped bottoms with a maximum depth of 1.5 meters and a minimum depth of 0.6 meters. The pond bottoms are gently sloping toward one end to allow for uniform draining and concentration of fish at harvest time. The pond banks are rip-rapped to reduce erosion and provide spawning areas for forage species.

3.2 Fertilization Regime

During this fertilization project six randomly selected 0.41 ha (1 acre) ponds were utilized at Minor E. Clark Fish Hatchery. Three ponds were fertilized using an organic and inorganic mix traditionally employed at the hatchery (control). These ponds received an initial fertilization of 4 bales of chopped hay, 181 kg of soybean meal, 68 kg of alfalfa meal, and 2.7 kg of potash (Table 1). The ponds also received 454 kg of lime prior to the fish being stocked. After the initial fertilization, ponds were fertilized within 12 days at varied rates. The amount and frequency of subsequent fertilizations were determined by the dissolved oxygen concentrations within each pond. When dissolved oxygen concentrations were above 2.5 mg L^{-1} at 0.75 meters depth, additional organic fertilizer was added. A total of about 642 kg (107 kg per week) of alfalfa meal was added to each pond, after the initial fertilization, over the course of this study (Table 1). These ponds were also fertilized with additions of 3.79 liters of 9-18-9 liquid fertilizer for each of the first three weeks after stocking, along with an addition of 1.36 kg of potash during the third week after stocking (Table 1).

Three 0.41 ha hatchery ponds were fertilized with inorganic N and P (the experimental ponds). Unlike the control ponds, which were filled one week prior to fish additions, these ponds were filled immediately before stocking. Dilute mixtures of liquid inorganic fertilizers (PO_4^{-1} and NO_3^{-1}) were sprayed on weekly. Loading was determined based upon pond nitrogen and phosphorus concentrations measured prior to spraying. Nitrogen (ammonium and nitrate) concentrations were raised to 0.6 mg L^{-1} and soluble reactive phosphorous concentration to 0.03 mg L^{-1} each week. These additions averaged 4.61 liters of NO_3^{-1} + NH_4^{-1} and 0.133 liters of PO_4^{-1} (Table 2). After stocking, if the ponds developed problems with filamentous alga growth, then algicide ($CuSO_4$) was applied. Additionally, if there were problems with anoxia within the ponds, the ponds were either flushed with fresh water, or physically mixed with tractor-powered paddlewheels. Ponds were seined periodically to determine growth rates (Fox and Flowers 1990).

3.3 Field Sampling Methods

Fertilization and sampling occurred from April through May 1997. Each pond was sampled biweekly at two sites, "kettle" (at the deep end near the water drain) and "mid" (the center of the pond), using acid washed Nalgene bottles.

At each pond site, Secchi depth was determined using a 20 cm black and white Secchi disk. Water samples were taken at three depths (surface, mid, and bottom) at each site using a 2 L Van Dorn water sampler.

Table1. Fertilizer addition means for control ponds (Weekly, kg or liters*) at Minor E. Clark Fish Hatchery during the 1997 growing season.

Week Applied	Potash	9-18-9*	Hay	Soybean Meal	Alfalfa Meal
April 2	2.7		64	181	68
April 14		3.79			91
April 21		3.79			91
April 28	1.4	3.79			83
May 5					144
May 12					151
May 19					83
Total	4.1	11.37	64	181	711

Table 2. Fertilizer addition means for experimental ponds per application (liters) at Minor E. Clark Fish Hatchery during the 1997 growing season.

Date Applied	28-0-0	Phosphoric Acid
April 18	3.68	0
April 25	2.34	0
April 28	4.47	0.165
May 2	5.28	0.158
May 9	6.27	0.239
May 16	5.71	0.159
May 23	4.54	0.207
Total	32.29	0.928

Five-hundred ml of water from each sample depth were combined in an acid washed bucket and used as a representative sample in determining each water quality parameter. A five-hundred ml sample was then taken from the acid washed bucket and transported to lab, on ice, for laboratory analysis. A total of 168 water samples were analyzed for each water quality parameter.

Dawn-Dusk-Dawn dissolved oxygen readings were recorded at each site and depth using an air calibrated YSI model 54 Dissolved Oxygen Meter. Dawn-Dusk and Dawn dissolved oxygen readings were used to calculate Net Primary Productivity (NPP) using equations from Wetzel and Likens (1991). Additionally, a Hydrolab Datasonde III™, with an internal data logger, recorded hourly pH, conductivity, dissolved oxygen, and temperature in one pond each day. The Hydrolab™ was placed in a different pond each day, between 06:30 and 07:00 am, rotating it between control and experimental ponds. The Hydrolab™ was calibrated and checked against NIST traceable standards to insure accuracy of the conductivity, pH, and temperature readings. Dissolved oxygen was air calibrated. Conductivity was measured using a YSI model 54 S-C-T meter during weekly sampling.

3.4 Laboratory Analysis

3.4.1 Chlorophyll *a*

Chlorophyll *a* analysis was completed by filtering 50 ml of the water sample through a pre-combusted Whattman GFA 0.45 μm glass fiber filters. The chlorophyll was extracted using 90% alkaline acetone (Wetzel and Likens 1991). The acetone with the dissolved pigments were analyzed flourometrically with a Turner model 10-AU flourometer (Turner Instruments, Sunnyvale, CA).

3.4.2 Water Chemistry Analysis

Duplicate analyses were run on all water samples. Alkalinity was measured by titrating into a 50 ml sample with 0.02 N H_2SO_4 to a pH endpoint of 5.0. Bromocreosol green-methyl red was used as an indicator (Larson and Henley 1955). Nitrate (NO_3) was determined using a variation of the sulfanilamide method following cadmium reduction of Henrickson and Selmer-Olsen (1970) and nitrate was measured as nitrite after cadmiun reduction (APHA 1995). Nitrite (NO_2) was analyzed using the Diazotization Method (APHA 1995) and ammonia (NH_3) was determined using a Nesslerization technique (Jenkins 1967). Soluble Reactive Phosphorous (SRP) was measured using the ascorbic acid method (Murphy and Riley 1962) on filtered water and total phosphorous was determined using the ascorbic acid method following a persulfate digestion (Sommers and Nelson 1972).

3.5 Biological Analysis

The plankton community was sampled at each site using a 12-L Schindler-Patalis Plankton trap with a 20 μm mesh size. Two tows were done within the photic zone at each site. Plankton were washed into a 125 ml Nalgene bottle and preserved with a

4% sweetened formalin solution and Lugol's iodine and kept refrigerated at 4°C until they were enumerated and identified (Wetzel and Likens 1991).

The phytoplankton were counted using a Nikon microscope, usually at 630X, equipped with Hoffman Modulation Contrast. A 100 µm subsample was pipetted on to a Palmer-Maloney counting cell and identified using keys by Prescott (1978,1982). Zooplankton 1ml subsamples were counted and identified using a Sedgewick-Rafer counting cell and a Nikon scope at 150X (Wetzel and Likens 1991). Zooplankton were identified using keys by Pennak (1989).

Walleye populations were sample seined three times during the experiment to determine growth rates and in order to establish harvest times. Walleye samples were measured to the nearest mm and health conditions evaluated.

3.6 Statistics

Statistical analysis was facilitated using Statview 4.0 for Macintosh (Abacus Concepts 1992). Comparisons of the pooled means of all water quality parameters were performed between the control and experimental ponds. Student's T-Test's were run on all water quality parameters after checking for normality in the data.

4.0 Results

4.1 Productivity

The mean Secchi transparency was significantly higher ($p<0.0001$, $n=72$) in the experimental ponds compared to the control ponds. Experimental ponds averaged 1.15 meters while the control ponds averaged 0.72 meters. The bottom of the experimental ponds were visible the majority of the time from May 8 until the end of the experiment (Figure 1). Secchi transparency within the control ponds varied little over the course of the experiment (Figure 1) after the initial sample date. Control pond Secchi transparency only exceeded one meter in one pond on three sample dates and one sample date in a second pond. Control pond Secchi transparency increased on April 27.

Mean chlorophyll *a* values were significantly lower ($p<0.0001$, $n=72$) in the experimental ponds. The experimental ponds averaged 6.64 $\mu g\ L^{-1}$ while the control ponds averaged 15.89 $\mu g\ L^{-1}$. Chlorophyll *a* levels generally increased in both pond types throughout the course of the experiment (Figure 2). On April 27, there was a large drop (21.2 and 6.3 $\mu g\ L^{-1}$) in chlorophyll *a* within both pond types (Figure 2), this may have been the result of heavy rains prior to the sampling period. The mean chlorophyll *a* measurements were consistently higher within the control ponds on each sample date (See Appendix 1).

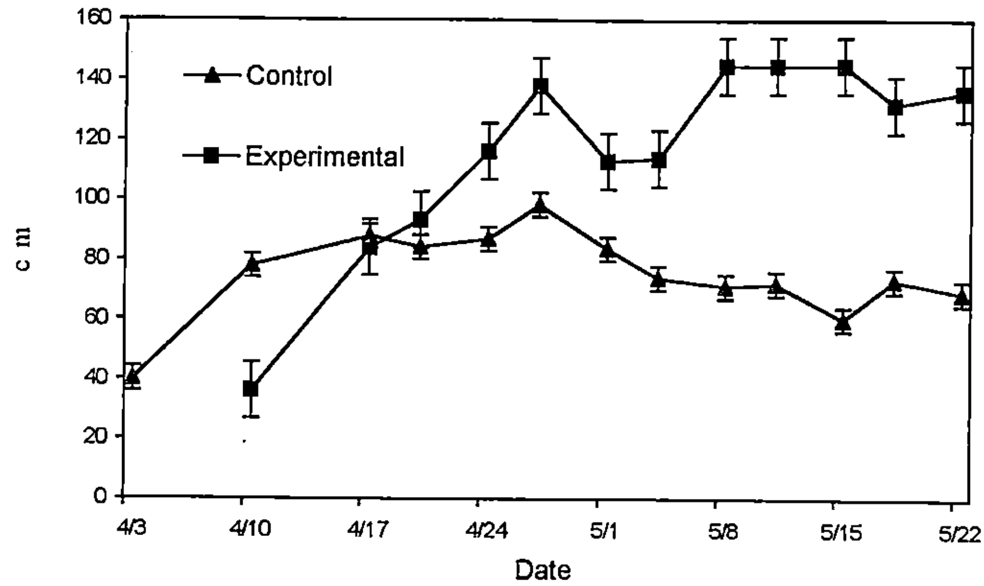


Figure 1. Mean Secchi Disk measurements (cm) within the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

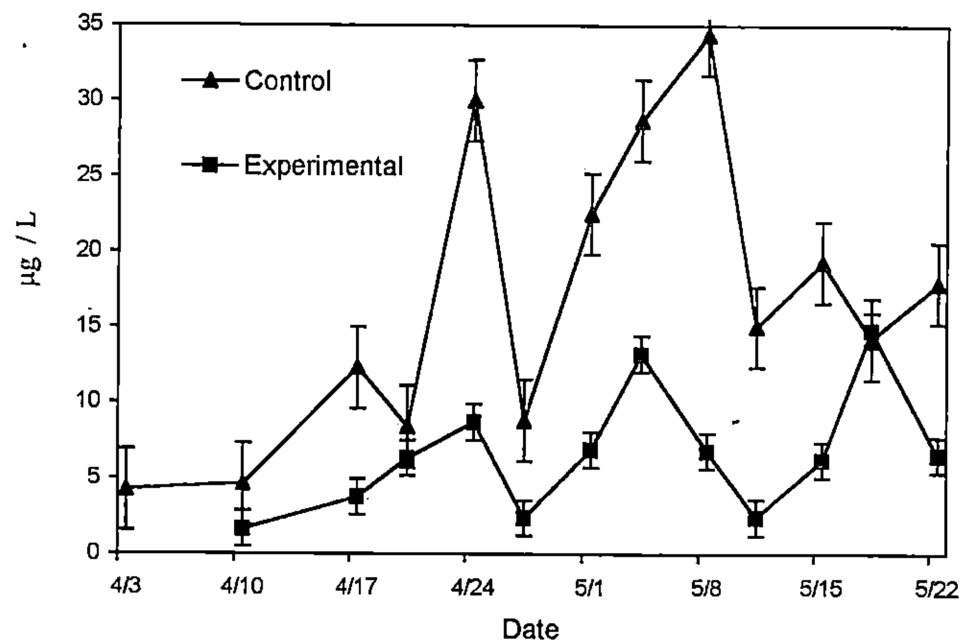


Figure 2. Mean chlorophyll *a* ($\mu g\ L^{-1}$) concentrations within the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

The chlorophyll *a* and Secchi disk measurements within the experimental ponds show a poor correlation ($r=0.0036$, $n=72$). However, the dates with the highest Secchi disk readings (April 27, May 8 and 11) were the ones with the lowest chlorophyll *a* concentrations (Figure 3) for the experimental ponds. Similar results were observed in the control ponds with a poor correlation ($r=0.019$, $n=84$) existing between Secchi disk and chlorophyll *a* data. However, the sample date with the highest mean Secchi disk measurement (April 27) was the date with the lowest chlorophyll *a* measurement (Figure 4).

Dissolved oxygen concentrations were significantly higher ($P<0.0001$, $n=684$) within the experimental ponds compared to the control ponds. The mean dissolved oxygen concentration within the experimental ponds was 11.21 mg L^{-1}, while the control ponds averaged 7.91 mg L^{-1}. Mean dissolved oxygen concentrations were significantly higher ($P<0.0001$, $n=184$) within the experimental ponds at each depth and sample time as compared to those obtained from the control ponds (Table 3).

Mean dissolved oxygen concentrations for samples collected at dawn did not fall below 4.0 mg L^{-1} for the surface or middle sites in either pond type (Figure 5). However, dawn dissolved oxygen concentrations did fall below 4.0 mg L^{-1} in both pond types at the bottom site (28% of the samples within control ponds compared to only 5% in experimental ponds).

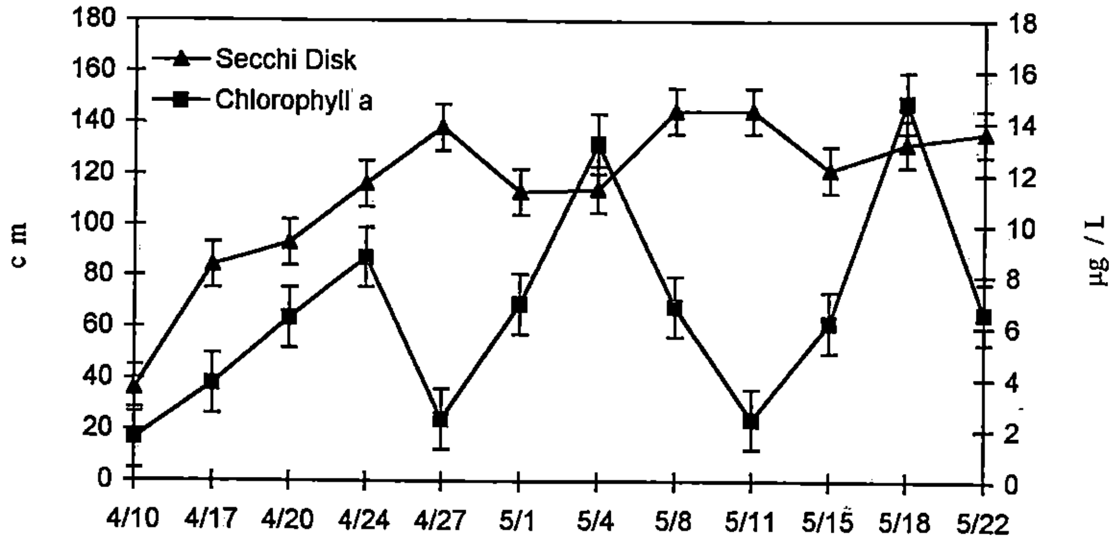


Figure 3. Experimental pond comparison of the mean Secchi Disk (cm) and Chlorophyll *a* ($\mu g\ L^{-1}$) at Minor E. Clark Fish Hatchery during the 1997 growing season.

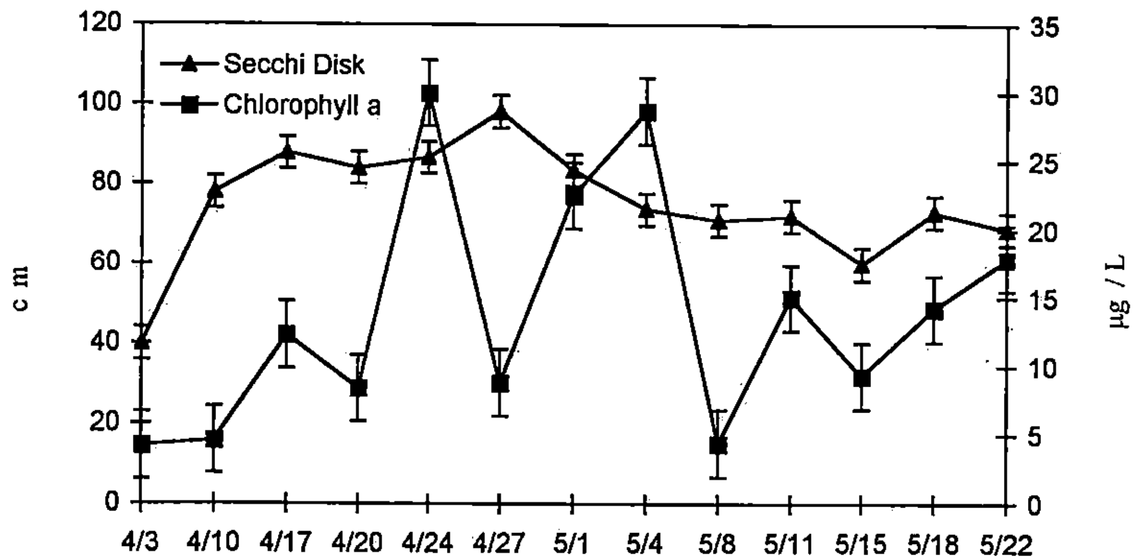


Figure 4. Control pond comparison of the mean Secchi Disk (cm) and Chlorophyll *a* ($\mu g\ L^{-1}$) at Minor E. Clark Fish Hatchery during the 1997 growing season.

Table 3. Mean dissolved oxygen concentrations at each depth and sample time within the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

Depth	Time	Experimental	Control	p
Surface	Dawn	10.57	7.55	0.0001
Middle	Dawn	10.59	7.34	0.0001
Bottom	Dawn	9.97	5.15	0.0001
Surface	Dusk	11.95	10.38	0.0001
Middle	Dusk	12.14	10.23	0.0001
Bottom	Dusk	12.02	6.78	0.0001
Total Mean		11.21	7.91	0.0001

$\pm$ 1 standard deviation

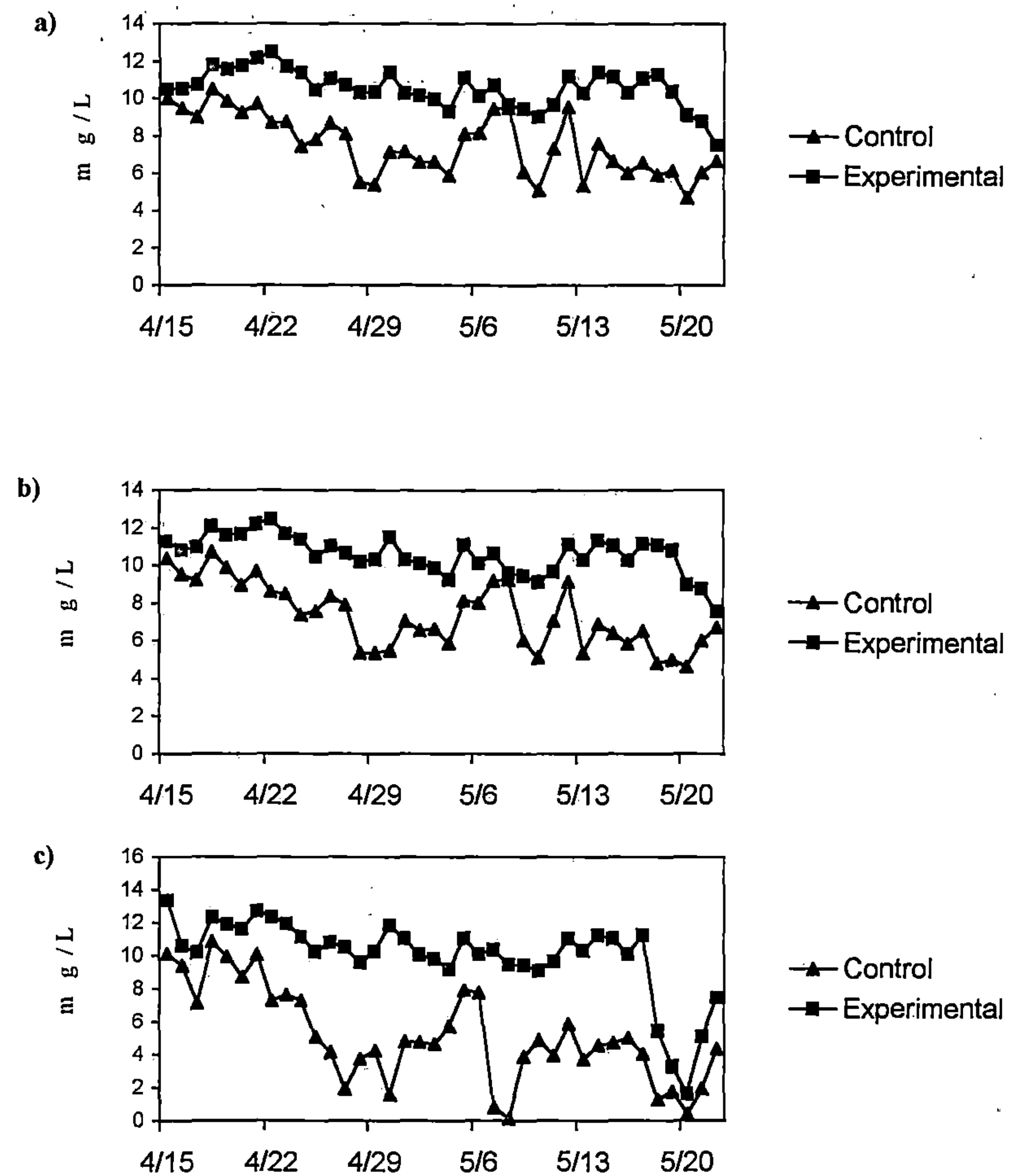


Figure 5. Mean dissolved oxygen concentrations (dawn) at each pond level: a) surface, b) middle, and c) bottom, within both experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

For water samples collected at dusk, dissolved oxygen concentrations did not fall below 4.0 mg L^{-1} within the experimental ponds (Figure 6). Among control ponds, dissolved oxygen concentrations did not fall below 4.0 mg L^{-1} at dusk at surface or middle sites, but did fall below 4.0 mg L^{-1} at the bottom site 22% of the samples (Figure 6).

The combined means for dissolved oxygen concentrations (all three depths) were compared for the dawn and dusk samples (Figure7). Data show that dissolved oxygen concentrations were significantly higher ($P<0.0001$, $n=342$) for both the dawn and dusk samples within the experimental ponds (See Appendix 3). On one sample date (May 22, the final sample date), the mean dissolved oxygen concentration was lower in the experimental ponds at dusk as compared to the control ponds (Figure 7). The probable cause of the increase in the dissolved oxygen concentrations in control ponds was the addition of fresh lake water in preparation for pond draining. Total combined dissolved oxygen (dawn and dusk at all three sites) was significantly higher ($P<0.0001$, $n=684$) within the experimental ponds. At no time, did the combined mean concentrations within the experimental ponds fall below that of the control ponds (Figure 7).

The mean change in dissolved oxygen (Δ D.O.) was determined, using dawn and dusk concentrations, within both pond types over the course of the experiment at all three depths. The control ponds had a higher mean Δ D.O. at the surface and middle sites than did the experimental ponds for the majority of the samples (Figure 8).

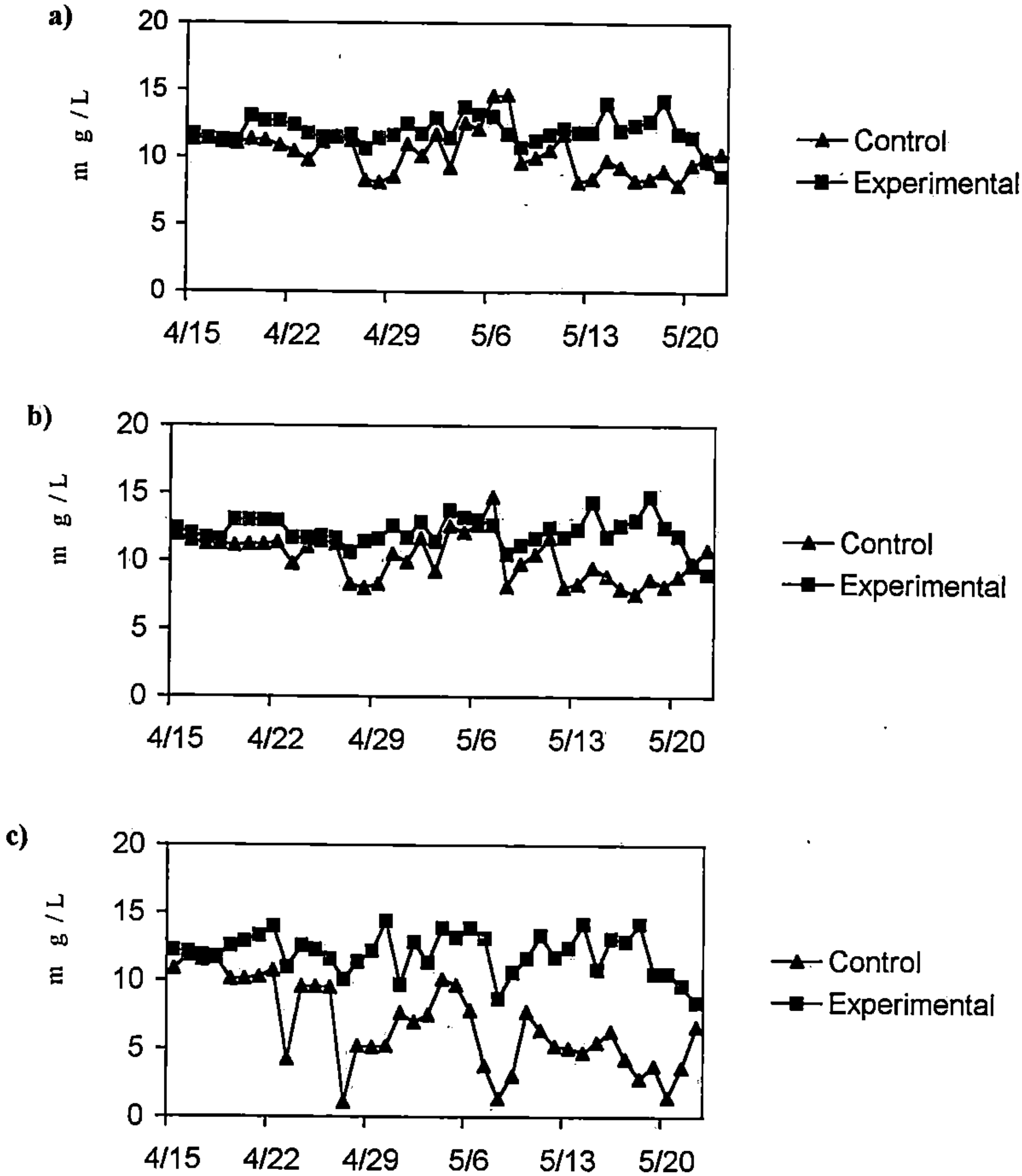
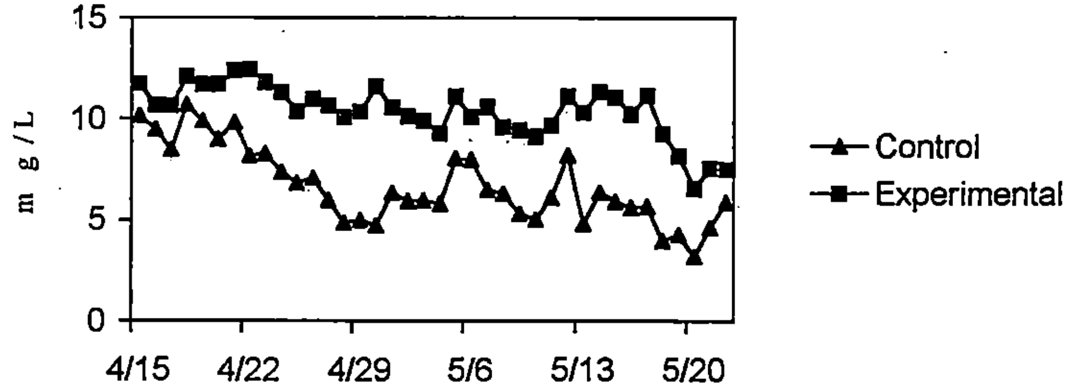
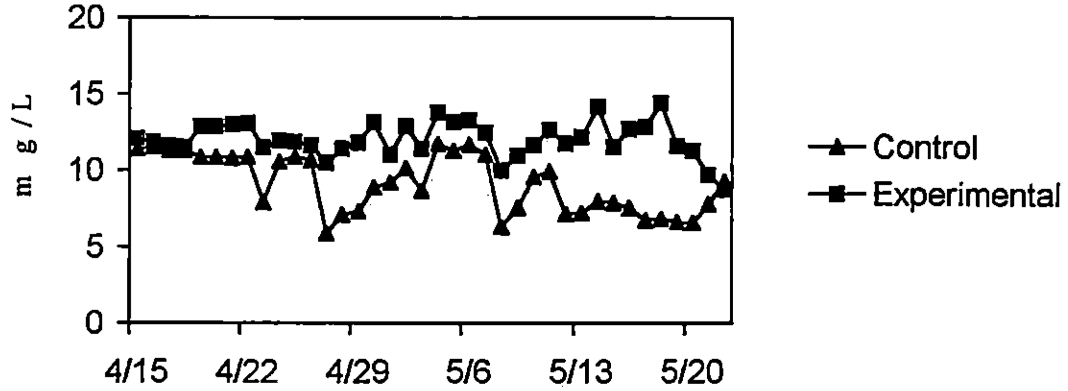


Figure 6. Mean dissolved oxygen concentrations (dusk) at each pond level: a) surface, b) middle, and c) bottom, within both experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

a)



b)



c)

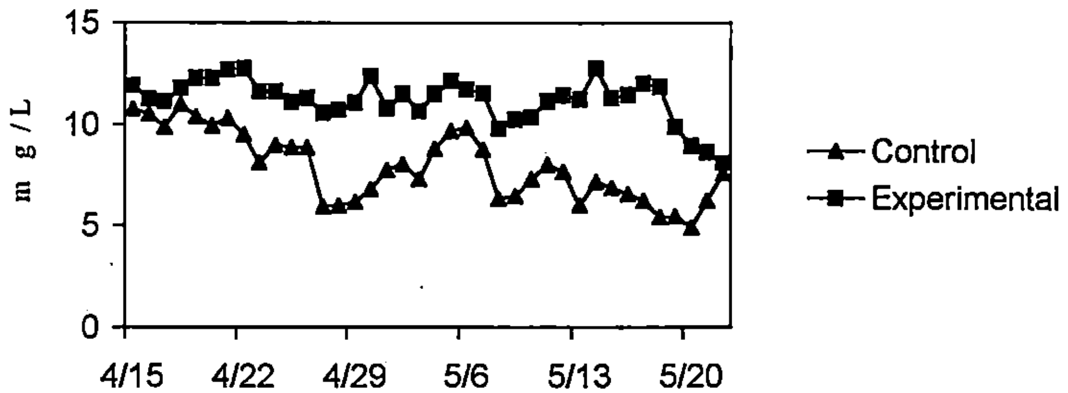


Figure 7. Comparison of combined mean dissolved oxygen concentrations for both experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season for all depths: a) Dawn concentrations, b) Dusk concentrations, and c) total combined concentrations.

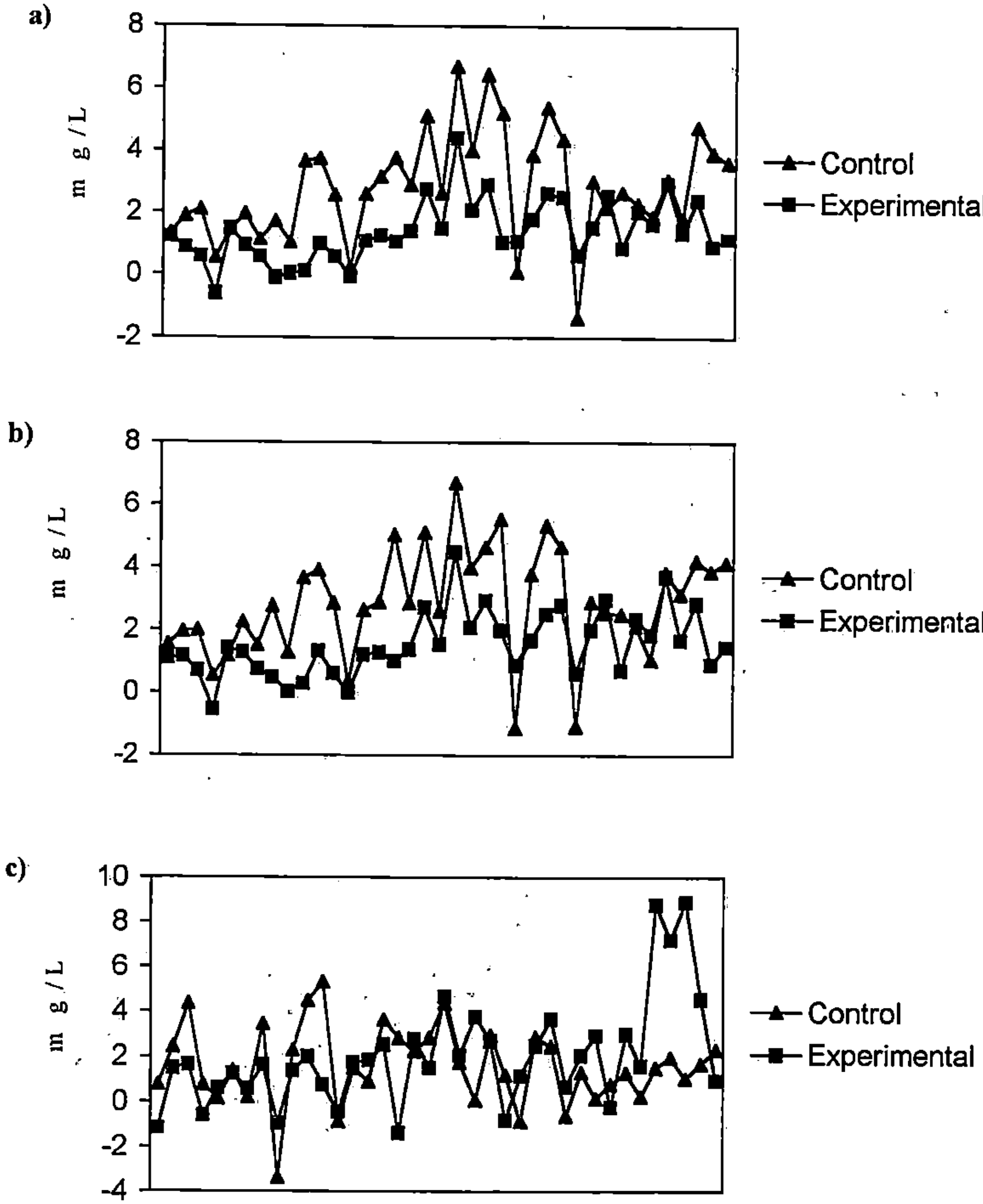


Figure 8. Mean Δdissolved oxygen concentrations at each level: a) surface, b) middle, and c) bottom, within both experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

However, the bottom site was not different between the two pond types.

Net Primary Productivity (NPP) was significantly lower ($p<0.001$, $n=30$) in the experimental ponds verses the control ponds at each depth except the bottom. Experimental ponds averaged 1.38 mg L^{-1} day^{-1}, 1.55 mg L^{-1} day^{-1}, and 2.07 mg L^{-1} day^{-1} at the surface, middle, and bottom depths respectively. The control ponds averaged 2.81 mg L^{-1} day^{-1}, 2.86 mg L^{-1} day^{-1} and 1.61 mg L^{-1} day^{-1} at the surface, middle, and bottom respectively.

4.2 Nutrients

4.2.1 Nitrogen

Total inorganic nitrogen concentrations (NO_3 and NH_4) were not significantly different between the two pond types (201 μg L^{-1} in the experimental ponds verses 213 μg L^{-1} in the control ponds). Similarly, mean nitrate concentrations were not significantly different between experimental ponds and control ponds (Figure 9); experimental ponds had an average of 145 μg L^{-1} while the control ponds averaged 128 μg L^{-1}. However, the mean ammonium concentrations were significantly lower ($p<0.002$, $n=72$) within the experimental ponds; experimental ponds averaged 55.5 μg L^{-1} while the control ponds averaged 85.1 μg L^{-1}. Nitrite means were not significantly different between the two pond types (5.4 μg L^{-1} experimental, 4.3 μg L^{-1} control) and did not contribute to the total inorganic N significantly (Figure 9).

4.2.2 Phosphorus

Total phosphorus concentrations were significantly lower ($p<0.0001$, $n=72$) within the experimental ponds verses the control ponds, (89.1 µg L-1 and 167.2 µg L-1 respectively). Mean total phosphorus concentrations in the experimental ponds were lower throughout the experiment (Figure 10). However, total phosphorus concentrations within the experimental ponds were significantly higher post-fertilization compared to pre-fertilization ($p<0.05$, $n=72$). Soluble reactive phosphorus (SRP) was low (6.6 µg L^{-1} within experimental ponds and 9.3 µg L^{-1} within control ponds), but was not significantly different between the two pond types (Figure 11). SRP varied over the course of the experiment. During the first two weeks after stocking, concentrations were <4.5 µg L^{-1} in both pond types. After two weeks, concentrations fluctuated with a peak of 13.2 µg L^{-1} and 28.3 µg L^{-1} within experimental and control ponds respectively (See Appendix 3). Additional peaks occurred on May 11 in the experimental ponds with SRP levels of 15.8 µg L^{-1} and on May 15 in control ponds when SRP levels reached 24.8 µg L^{-1} (Figure 11).

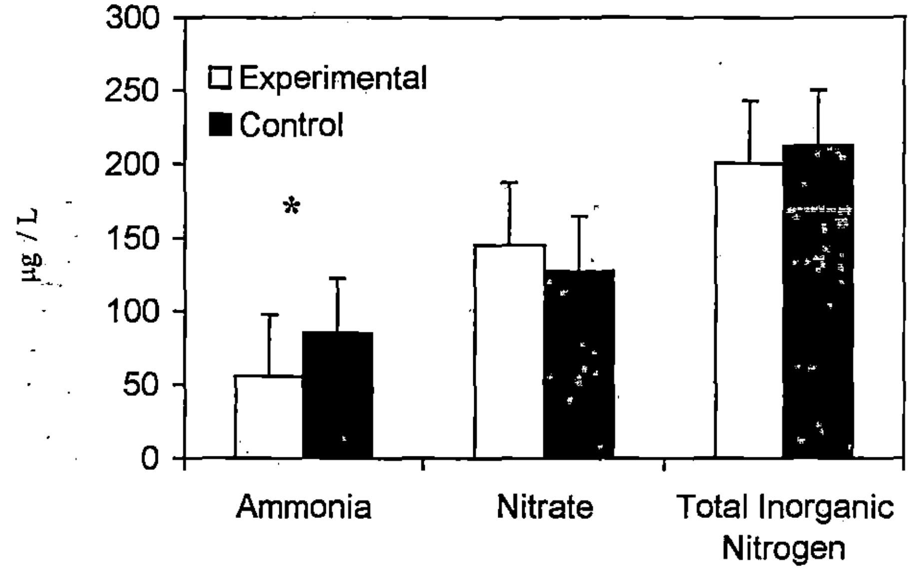


Figure 9. Mean ammonia, nitrate, and total inorganic nitrogen concentrations for the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season. * Significantly different. ($p<0.002$, $n=72$)

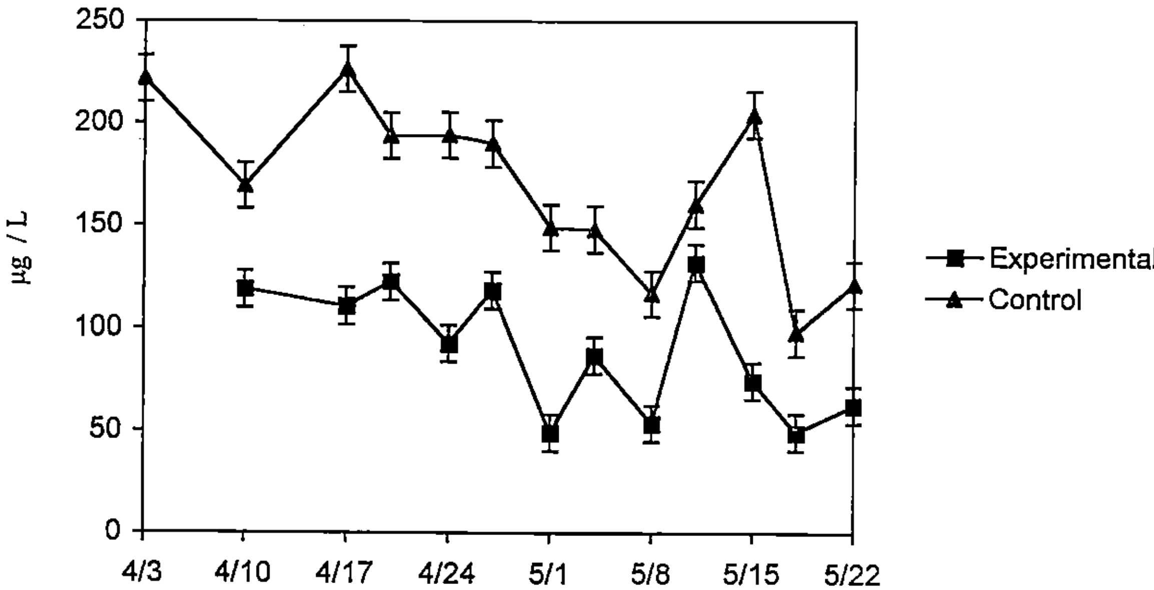


Figure 10. Ponds mean concentrations of Total Phosphorous (µg L^{-1}) within experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

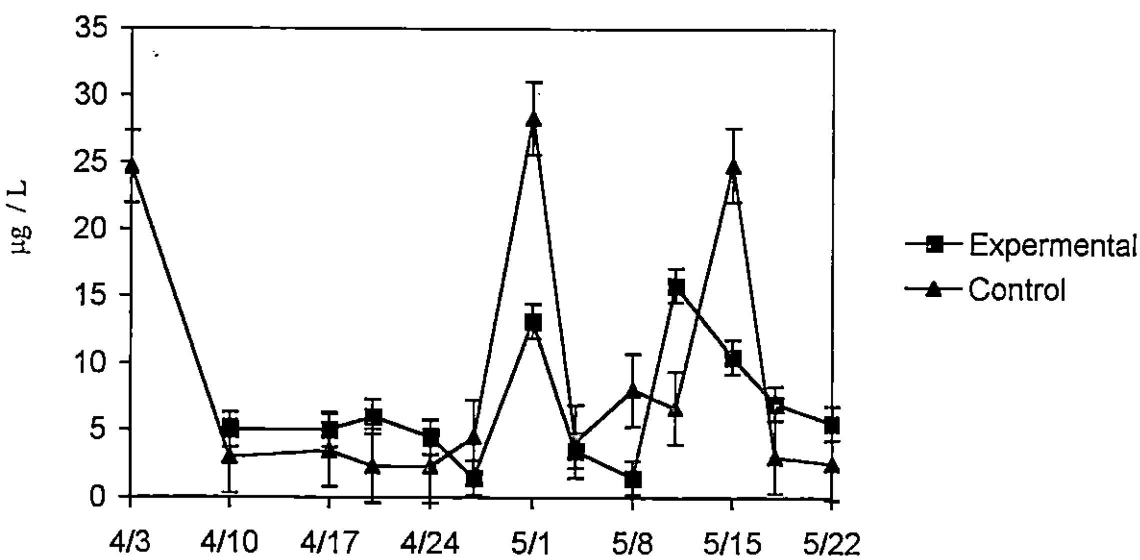


Figure 11. Ponds mean concentrations of SRP (µg L^{-1}) within the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

4.3 Other Variables

Pond temperatures ranged from 9° to 20° C over the course of the experiment. Initially, the water temperature was 9° due to the cold water received from Cave Run Lake at the time the ponds were filled. However, temperatures quickly rose to 13° within one week of the fill date.

Alkalinity means were significantly lower ($P<0.0001$, $n=72$) in the experimental ponds. The control ponds averaged 57.61 mg L^{-1} $CaCO_3$ and experimental ponds averaged 34.05 mg L^{-1} $CaCO_3$. Higher alkalinity within the control ponds might have been due to the addition of lime; however, alkalinity concentrations gradually increased over the course of the experiment (Figure 12) despite lime being added just once (prior to stocking).

Differences in the daily high pH and low pH were compared in each pond type. Average daily high pH and low pH values were significantly different ($p<0.001$, $n=30$) for the experimental verses the control ponds (Figure 13). Experimental pond low and high pH means were 9.10 and 9.48, while the control pond means were 7.89 and 8.55. The diel changes in pH were also significantly different ($p<0.005$, $n=30$), with the experimental ponds mean diel variation being lower (0.38) than the control ponds (0.66) (Figure 13).

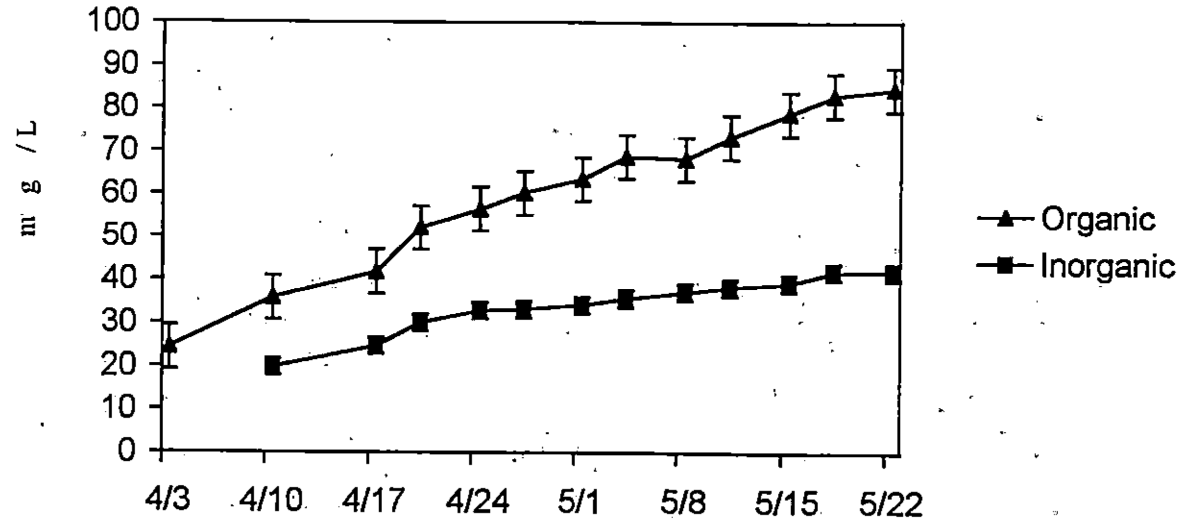


Figure 12. Mean Alkalinity concentrations ($CaCO_3$ mg L^{-1}) within experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

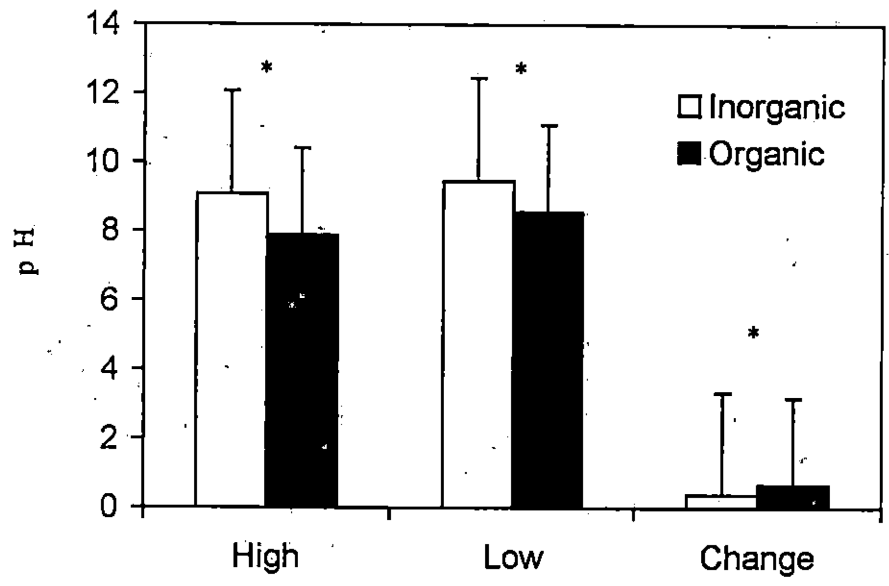


Figure 13. Mean pH for the highest and lowest measurements per day and ΔpH for the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season. * Significantly different. ($p<0.005$, $n=30$)

4.4 Walleye Production

Control ponds were stocked with an average of 109,000 walleye fry while the experimental ponds were stocked with an average of 110,000. Survival averaged 37.3% in the experimental ponds and 86.7% in the control ponds. Walleye production averaged 36.32 kg ha^{-1} in the experimental ponds and 78.76 kg ha^{-1} in the control ponds. Walleye from the experimental ponds averaged 552.0 fish per kg and 38.61 mm in length at harvest, while those from the control ponds averaged 611.0 fish per kg and 36.41 mm in length.

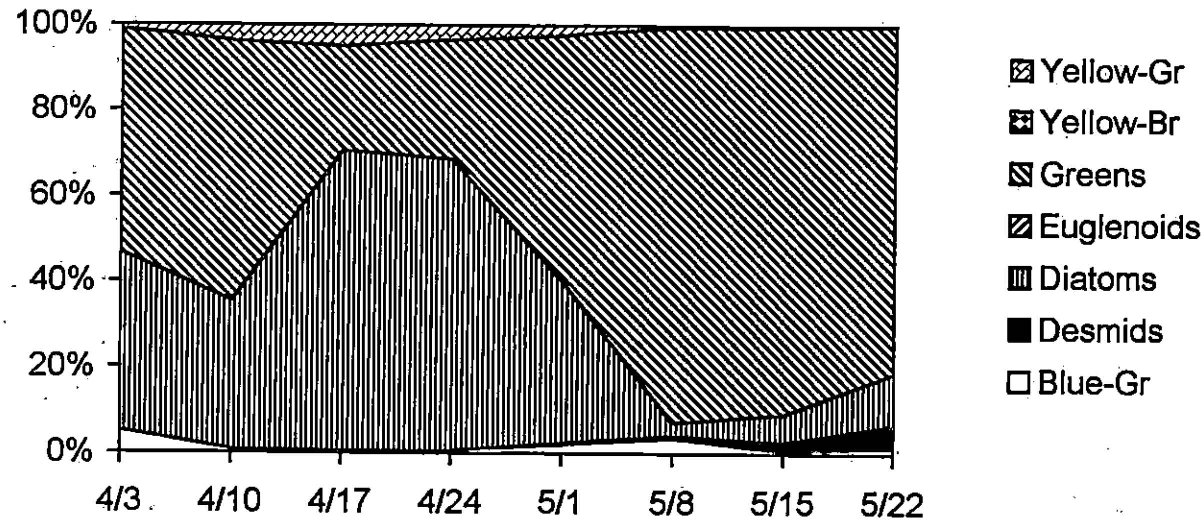
Walleye in control ponds grew faster than did those in experimental ponds for the first five weeks after stocking. During week four to five, growth was determined to be 0.58 mm day^{-1} within the experimental ponds compared to 0.64 mm day^{-1} in the control ponds. Walleye averaged 16.26 mm in length within the experimental ponds compared to 22.1 mm in the control ponds at this sample date. Week six saw an increase in growth to a mean of 1.07 mm day^{-1} in the experimental compared to 0.89 mm day^{-1} in the control, and a mean length increase of 22.1 mm and 28.45 mm respectively. Week six to harvest showed an increase in growth within the experimental ponds to 1.12 mm day^{-1}, but the control ponds experienced a decrease in growth to 0.51 mm day^{-1}.

4.5 Plankton Production

4.5.1 Phytoplankton

Phytoplankton communities were divided into seven taxonomic groups: Bacillariophyceae (Diatoms), Chlorophyta (Greens), Chrysophyta (Yellow-Brown), Cyanophyta (Blue-Green), Desmids, Euglenophyta (Euglenoids), and Xanthophyceae (Yellow-Green). Experimental ponds had an initial phytoplankton community comprised of 46% Chlorophyta, 42% Diatoms, and 12% Cyanophyta + Xanthophyceae. The initial phytoplankton community was very similar to the findings of Davis (1995), that showed Cave Run Lake phytoplankton communities were dominated by Chlorophyta and Bacillariophyceace in early May (See Appendix 4 and 6). After the walleye were stocked (April 11-12), Chrysophyta, Cyanophyta, Desmids, Euglenophyta, and Xanthophyceae comprised less than 2% of the total population until the final sampling date (Figure 14). During week two there was an increase in Chlorophyta (62%) and a decrease in Diatoms (36%), with other species comprising the remaining 2% (Figure 14). During weeks three through six, Chlorophyta and Diatoms comprised 98% to near 100% of the phytoplankton community; weeks three and four were dominated by Diatoms (50% and 66%), while five and six were dominated by Chlorophyta (82% and 83%). Additionally, Chlorophyta and Diatoms remained dominant during the final sampling date (46% and 35% respectively), Cyanophyta and Desmids comprised equally 19% of the phytoplankton community (Figure 14).

Control composition



Experimental composition

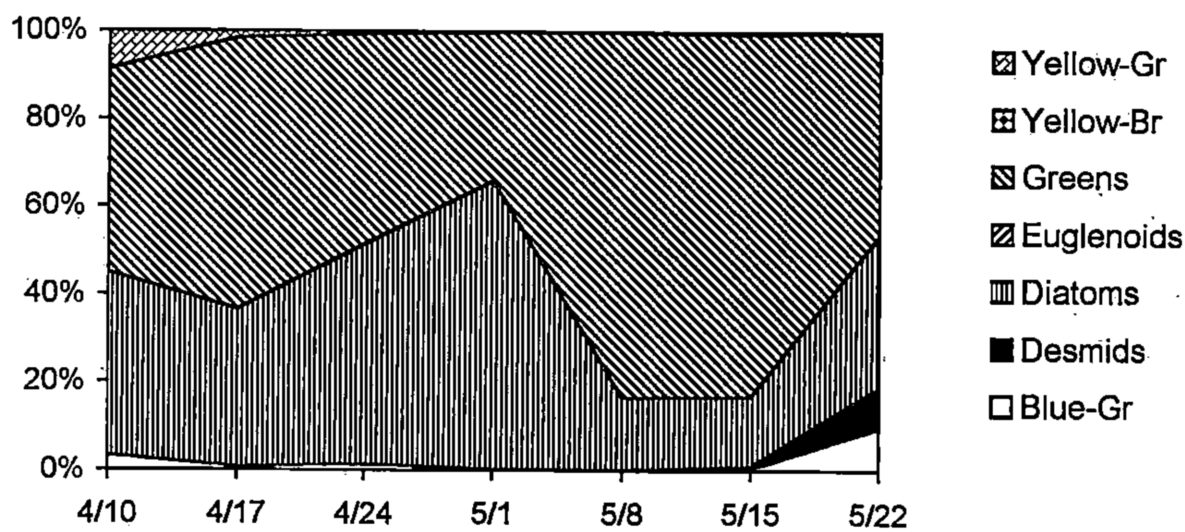


Figure 14. Phytoplankton percent composition within the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

Control pond phytoplankton communities were dominated by Chlorophyta and Diatoms (93% to 98%) the entire length of the project (Figure 14). Prior to Walleye stocking, Chlorophyta was dominant (52% to 61%) with most of the remainder comprised of Diatoms (35% to 41%). The phytoplankton community was also similar to that found by Davis (1995) within Cave Run Lake. Following stocking, Diatoms became the dominant group (70% and 68%) for weeks three and four. Chlorophyta (81% to 92%) dominated weeks eight through ten (Figure 14). The other groups comprised less than 6% of the population during the growing season.

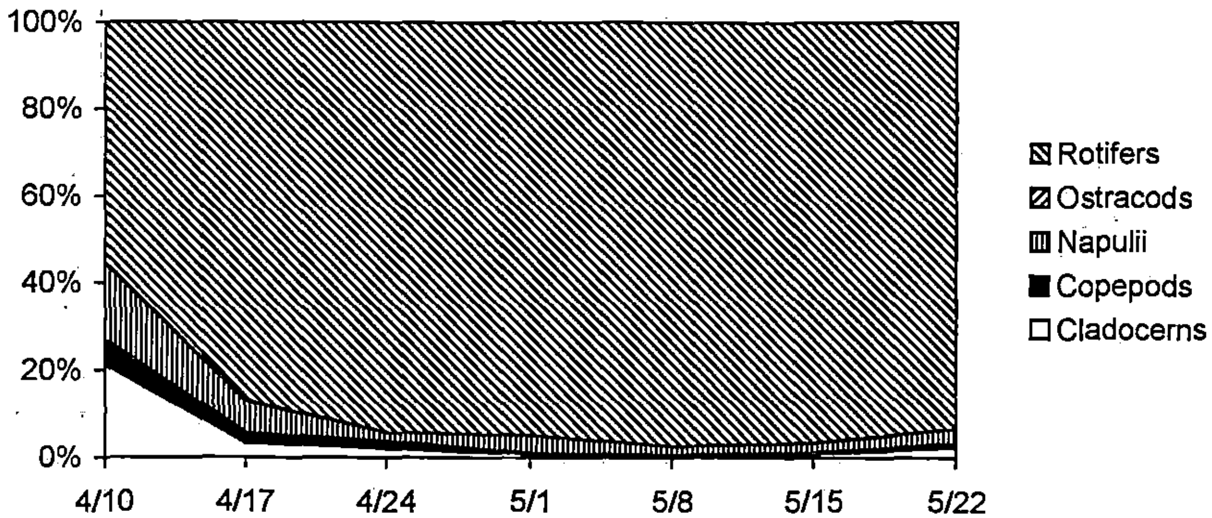
4.5.2 Zooplankton

Zooplankton communities were divided into five taxonomic groups: Cladocerns, adult Copepods + Copepids, larval Copepod napulii, Ostracods, and Rotifers. Rotifers dominated the community structure within the experimental ponds for the entire length of the experiment. Initially, rotifers comprised 55% of the zooplankton population with cladocerns and larval napulii making up another 39% (Figure 15). However, Davis (1995) found that Cave Run Lake zooplankton populations were comprised of adult copepods (24%), napulii (14%), cladocerns (30%), rotifer (30%), and ostradcods (2%) in early May. A week later, the population was 87% rotifers with the majority of the remainder comprised of napulii. For the remainder of the experiment, the community was 93% to 98% rotifers (Figure 15).

Zooplankton populations within the control ponds prior to stocking were comprised of larval napulii (39%), rotifers (34%), copepods (18%), cladocerans (8%), and ostracods (1%). This community more closely resembles the community seen by Davis (1995) than that within the experimental ponds. Rotifers were dominant from week two until harvest, ranging from 54% to 98% of the population (Figure 15). Napulii comprised 4% to 13% week two through week seven. No other group was ever dominant with the exception of a large bloom of copepods starting in week four (as the larval napulii matured) which ended in week seven (See Appendix 5 and 7). Copepod dominance ranged from 6% to 40% of the community during this time (Figure 15).

Total mean numbers of zooplankton peaked twice within the control ponds, on May 1 at 12,282 individuals L^{-1} and May 22 at 7,654 individuals L^{-1} (Figure 16). Both peaks were dominated by rotifers 10,810 individuals L^{-1} and 7,485 individuals L^{-1} respectively (Figure 17). The total mean numbers of zooplankton within the experimental ponds gradually increased until they peaked on the last sample date (May 22) at 9,135 L^{-1}. This peak was dominated by rotifers at 8,534 individuals L^{-1} (Figure 17). Density was greater within the control ponds until May 8, when their numbers dropped to 895 individuals L^{-1}, compared to 3,331 individuals L^{-1} within the experimental ponds (Figure 16). The mean numbers enumerated were higher within the experimental ponds until walleye harvest (Figure 16).

Experimental composition



Control composition

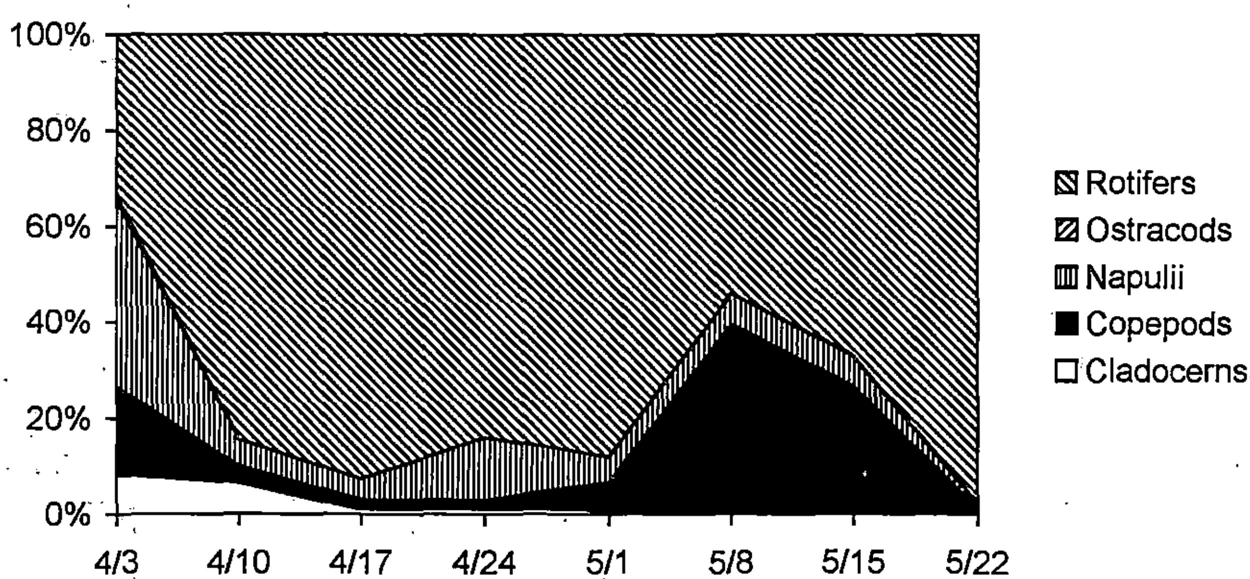


Figure 15. Zooplankton percent composition within the experimental and control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

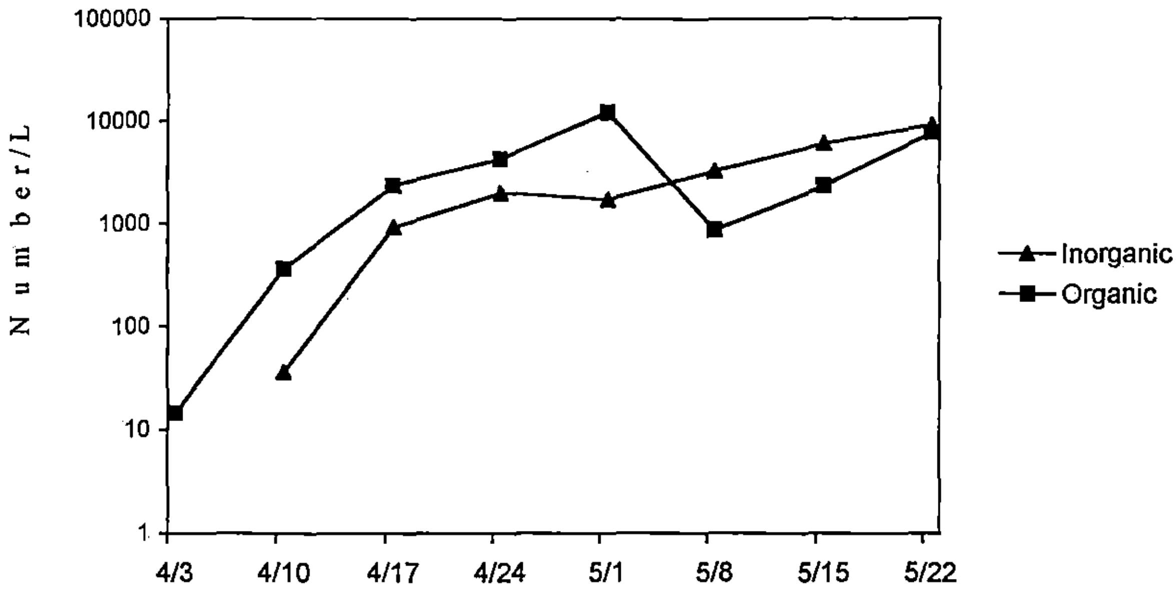
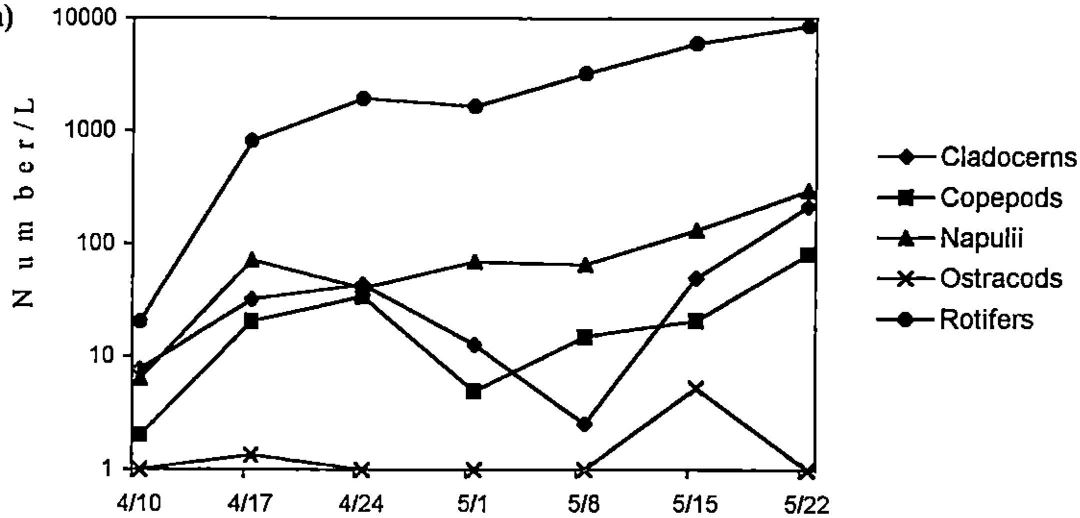


Figure 16. The mean total zooplankton numbers per liter within the experimental and the control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

a)



b)

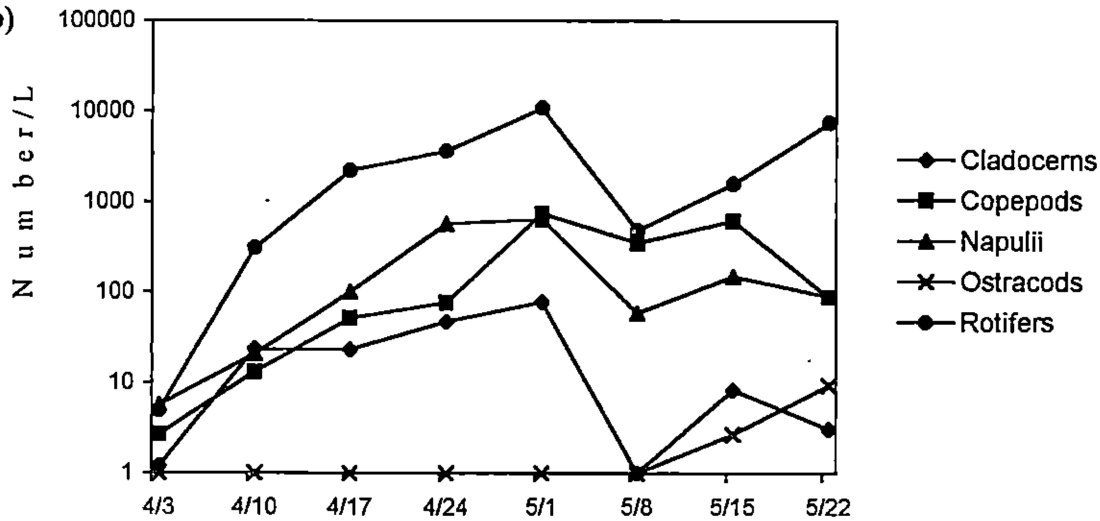


Figure 17. Zooplankton mean numbers L^{-1} within: a) experimental and b) control ponds at Minor E. Clark Fish Hatchery during the 1997 growing season.

5.0 Discussion

5.1 Fertilization

Fertilization has long been an important component of game fish aquaculture. Fertilization is a bottom up manipulation within hatchery ponds, where an increase in nutrients leads to an increase in phytoplankton and zooplankton, and eventually to an increase in fish production. The primary goal of hatchery managers is to achieve optimal fish production within a given pond, without undue stress upon the fish, at the lowest cost. Both types of fertilization (experimental and control) seem to provide enough important nutrients to ensure that sufficient plankton blooms develop to promote fish growth. Less time was required to fertilize the experimental ponds, which is an important consideration for hatchery managers.

Comparisons of monetary costs for each type of fertilization program were determined based on fertilizer costs alone. Experimental fertilizer costs were \$152.27 ha^{-1}, while the total cost for control fertilizers were \$859.73 ha^{-1}. Experimental fertilization was \$707.46 ha^{-1} less expensive than traditional fertilization. This would result in annual savings for walleye culture of \$5100.00 to \$6000.00 per year if this program were fully utilized at MCFH. However, there were other costs associated with the experimental fertilization program that make it not cost effective.

Anoxia was not a problem within either pond type during this production year. Uncharacteristically, only one control pond within this study required supplemental aeration this year. To combat anoxic, this pond was flushed with water the week prior to harvest. Other walleye hatchery ponds did require supplemental aeration during this production year. No experimental pond required supplemental aeration at any point. Anoxia was probably not as common this year as in years past due to cooler air temperatures.

5.2 Nutrient Response

The concentration's of SRP were very low within both pond types, which indicates that phytoplankton were rapidly utilizing SRP added through fertilization. Because there were no significant differences between pond types, it can be assumed that both fertilization programs were adding the required amounts of SRP for fish production. SRP concentrations within the experimental ponds were not significantly different pre-fertilization or post-fertilization. This also supports the theory that SRP was being taken up quickly after addition. SRP concentrations within both pond types were lower than those found by Qin and Culver (1992). They found mean SRP concentrations of 12.40 $\mu g\ L^{-1}$ and 14.86 $\mu g\ L^{-1}$ within ponds fertilized with inorganic fertilizers only, and inorganic and organic fertilizers combined, while this research obtained 6.85 $\mu g\ L^{-1}$ and 9.25 $\mu g\ L^{-1}$ respectively. Qin and Culver (1995) demonstrated that the highest SRP occurred when zooplankton populations were at there highest. SRP concentrations were generally trending upward, with the exception of two large peaks within both pond types. A similar SRP pattern to that of Qin and

Culver (1995) was observed in both pond types without the large one-day peaks that were experienced within the experimental and control ponds.

Total phosphorous concentrations were significantly higher within the control ponds. This was as expected because of the addition of large amounts of organic fertilizers (264.2 kg ha^{-1} of alfalfa meal per week) that contain high concentrations of total phosphorus and the large numbers of plankton present within these ponds. The total phosphorous concentrations were higher within the experimental ponds post-fertilization. Total phosphorous concentrations within the experimental ponds were lower than those achieved by Qin and Culver (1995), but the total phosphorous concentrations in the control ponds were higher.

Total inorganic nitrogen was not significantly different between the two pond types. However, NH_4 was significantly lower in the experimental ponds compared to the control, because of the large amount of decomposition needed for organic fertilizers. NO_3 was not significantly different between the two pond types. Qin and Culver (1992) also found NH_4 concentrations were significantly lower in ponds fertilized with only inorganic fertilizers as compared to those fertilized with inorganic and organic fertilizers (42 $\mu g\ L^{-1}$ and 148 $\mu g\ L^{-1}$ respectively). This is an added benefit at high pH, because it reduces the chance of $NH_4(OH)$ production which could lead to fish kills. Qin and Culver (1992) did not have significant differences in mean NO_3 concentrations between inorganic and inorganic combined with organic fertilization programs. These results show that the nutrient concentrations achieved were similar to those reported by Qin and Culver (1992).

5.3 Chemical Variables

Experimental ponds had significantly lower alkalinity than the control ponds. The experimental ponds gradually increased throughout the experiment, but averaged below 20 mg L^{-1} before fertilization. Boyd (1990) documented that primary productivity was carbon limited in aquatic ecosystems at alkalinities below 20 mg L^{-1} $CaCO_3$. Tice et al. (1996) suspected that low alkalinities limited walleye production when utilizing the fertilization plan laid out by Culver et al. (1993) at Pleasant Mount Fish Cultural Station in Pleasant Mount, Pennsylvania. However, Cole (1997), found that carbon was rarely, if ever, a limiting nutrient in freshwater environments even at low alkalinities. Because alkalinities did not exceed 40 mg L^{-1} until the final week, it is possible, but not likely, that there was a carbon-limitation within the experimental ponds. The control ponds were above 20 mg L^{-1} $CaCO_3$ prior to stocking and remained above that the entire season, eliminating the possibility of carbon limitation.

5.4 Physical Variables

Secchi depth is used as a measurement to determine productivity for some trophic state indices (Carlson 1977). Secchi depths were shallower within control ponds throughout the entire fertilization project when compared with the experimental ponds. Average Secchi depths were over 93 cm after one week for the control ponds.

Secchi depths indicate that the control ponds were much more productive than the experimental ponds. Chlorophyll *a*, which is inversely proportional to transparency, was significantly higher within the control ponds. There was a poor correlation between chlorophyll *a* and Secchi disk measurements within both pond types, however the dates with the highest Secchi depths were also the dates with the lowest chlorophyll *a* concentrations. This suggests that some of the variations within Secchi transparency were caused by chlorophyll *a* concentrations, but other factors (e.g. nonalgal turbidity) probably prevented a direct relationship. This was especially true within one experimental pond, which experienced a problem with high turbidity after filling and did not achieve Secchi depths equal to the other experimental ponds until over two weeks into the experiment. This was possibly caused by the rapid filling required to meet the experimental guidelines (filling as close to stocking walleye as possible).

5.5 Community Structure

5.5.1 Phytoplankton

Phytoplankton communities were dominated by green algae and diatoms within both pond types throughout the course of this experiment. However, the total numbers of plankton cells within the experimental ponds were about 27% lower than within the control ponds. This plankton shortage could have been one of the problems with utilizing this fertilization program at MCFH this year. Zooplankton grazing and/or a nutrient limitation controlled phytoplankton populations within the study ponds.

Fertilization at a low N:P ratio can result in blue-green algae blooms, but no large blue-green blooms were seen within either pond type. Therefore, it was not necessary to apply $CuSO_4$ to eliminate problematic algae blooms (bluegreen and filamentous) within any of the study ponds. However, $CuSO_4$ was applied to several other walleye hatchery ponds, not involved with this study, to eliminate problematic algal blooms even with cooler than average temperatures.

Culver (1991) hypothesized that filamentous algae would be reduced by maintaining a high N:P (20:1) ratio. Filamentous algae were not a problem within either pond type at any time. However, Tice et al. (1996) did experience fish loss due to entanglement within filamentous algae in ponds utilizing the Culver et al. (1993) methods. This shows a possible problem with implementation of the fertilization program at other hatcheries without further studies into the fertilizer, nutrient, and phytoplankton interactions.

5.5.2 Zooplankton

Both fertilization types resulted in similar zooplankton blooms (dominated by rotifers early within the experiment). This is to be expected because walleye do not select for rotifers because of their small size (Qin and Culver 1992), which allowed them to increase in numbers. The control ponds experienced a copepod bloom later into the study, which indicated that there were surplus numbers of copepods or enough other more desirable food available to allow copepods to increase in numbers. Because walleye, like many planktivours, forage optimally (Graham and Sprules 1992), the experimental ponds became dominated by rotifers quickly (one week after stocking, 87%). This indicates that they were food limited and probably starved after several weeks.

5.6 Fish Production

The experimental ponds fell far short of the mean fish production and survival achieved by Culver et. al (1993). Walleye production and survival within the experimental ponds was 36.3 kg ha^{-1} and 26.7% less than that achieved by Culver et. al (1993). However, the control ponds surpassed Culver's production and survival by 6.1 kg ha^{-1} and 14.7%. The combined means (production and survival) at MCFH of all other walleye hatchery ponds also surpassed Culver's production and survival as well (Brewer, personal communication). Within the last five years, there has been only one bust pond (survival of less than ten percent) at MCFH. In fact, survival over that time period has averaged over 93% (Brewer, personal communication).

One consideration with the experimental ponds is the fact that one of the ponds had very low survival of 11%. This pond could be classified as a bust pond by most standards. Without this pond the overall survival and production would increase to 50.4% and 47.8 kg ha^{-1}. Although these numbers are still far short of those achieved by Culver, they are probably a better estimate of what such a program could achieve at

MCFH.

5.7 Conclusions and Recommendations

Recent attempts to replicate Culver et al. (1993) results have generally come up short in production and survival at high-density stockings. It is possible that this fertilization program will need to be varied on a site by site bases to accommodate local variations in water quality, water supply, and weather conditions. One factor that may have made a difference with this experiment was control over fill time. The inflow water source (Cave Run Lake) was very turbid when the ponds were filled because of heavy rains within the drainage basin. This led to turbid water conditions, which delayed plankton growth within the experimental ponds because of their late fill time. If these ponds had been given a few days to allow sediments to settle out of the water, then they may have had greater survival.

Another factor reducing production may have been the lower than average air temperatures during the course of the experiment. April mean temperatures were 2.7°C below normal; while May temperatures were 4.0°C below the thirty year average (NOAA, 1998). One temperature decline occurred two days prior to stocking when temperatures dropped from 19.3°C to 0.9°C; another occurred two days after stocking (temperatures declined from 15.6°C to 4.3°C for two days). Although the first decline would not have affected the experimental ponds because they were not full at the time of the temperature decline, the second decline could have possibly delayed the initial phytoplankton bloom at a critical point (immediately after fish stocking). Phytoplankton numbers per liter were not calculated, so this effect can not be fully determined. There were no notable changes in water quality except decreases in water temperature of up to 3°C during these temperature declines.

The experimental, inorganic only, fertilization program had many "costs" at MCFH. These "costs" include: 1) losses in fish production, 2) additional time required for water quality analysis, 3) purchasing necessary lab equipment, and 4) extra pond space required to produce the same number of fish to meet the stocking requirements for Kentucky waters. These added "costs" do not out weigh the advantages of higher dissolved oxygen, lower financial expense, and less time required for fertilizer application. At MCFH, the traditional fertilization method worked better than the experimental method without the added costs associated with inorganic fertilization. More research would be required before implementing an inorganic fertilization program at a historically highly productive hatchery such as MCFH. Data from MCFH has shown that it is possible to utilize organic and inorganic fertilizers to achieve high fish production requirements with careful gradual additions of fertilizer and a watchful eye on dissolved oxygen concentrations, if supplemental aeration is available through water additions and utilization of paddlewheels.

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Appendix 1. Rearing pond physical and chemical data for each site for the 1997 growing season.

Appendix 1: Inorganic Pond 19 physical and chemical data.

Date	Pond	Site	NO3 µg/L	NO2 µg/L	NH4 µg/L
4/10/97	19	Kettle	600	6	101
4/10/97	19	Lower	600	5	105
4/17/97	19	Kettle	300	8	70
4/17/97	19	Lower	300	9	70
4/20/97	19	Kettle	160	8	91
4/20/97	19	Lower	150	8	57
4/24/97	19	Kettle	300	8	11
4/24/97	19	Lower	200	8	9
4/27/97	19	Kettle	200	7	17
4/27/97	19	Lower	100	6	0
5/1/97	19	Kettle	100	7	23
5/1/97	19	Lower	100	6	33
5/4/97	19	Kettle	120	6	16
5/4/97	19	Lower	130	7	33
5/8/97	19	Kettle	30	4	34
5/8/97	19	Lower	30	3	20
5/11/97	19	Kettle	120	4	149
5/11/97	19	Lower	120	4	144
5/15/97	19	Kettle	70	7	95
5/15/97	19	Lower	70	6	57
5/18/97	19	Kettle	100	6	19
5/18/97	19	Lower	100	7	7
5/22/97	19	Kettle	60	6	160
5/22/97	19	Lower	50	7	156

Organic Pond 21 physical and chemical data.

Date	Pond	Site	NO3 µg/L	NO2 µg/L	NH4 µg/L
4/1/97	21	Kettle	600	14	254
4/1/97	21	Lower	500	15	218
4/3/97	21	Kettle	300	10	98
4/3/97	21	Lower	300	9	107
4/10/97	21	Kettle	200	5	80
4/10/97	21	Lower	200	6	80
4/17/97	21	Kettle	100	1	136
4/17/97	21	Lower	100	1	81
4/20/97	21	Kettle	10	1	40
4/20/97	21	Lower	10	1	55
4/24/97	21	Kettle	100	2	45
4/24/97	21	Lower	100	3	53
4/27/97	21	Kettle	200	1	17
4/27/97	21	Lower	200	2	19
5/1/97	21	Kettle	20	3	0
5/1/97	21	Lower	40	3	0
5/4/97	21	Kettle	40	3	43
5/4/97	21	Lower	40	3	43
5/8/97	21	Kettle	30	5	5
5/8/97	21	Lower	20	5	0
5/11/97	21	Kettle	40	4	155
5/11/97	21	Lower	40	4	98
5/15/97	21	Kettle	20	4	143
5/15/97	21	Lower	30	5	113
5/18/97	21	Kettle	20	3	60
5/18/97	21	Lower	30	3	57
5/22/97	21	Kettle	30	2	95
5/22/97	21	Lower	30	1	79

Organic Pond 30 physical and chemical data.

Date	Pond	Site	NO3 µg/L	NO2 µg/L	NH4 µg/L
4/1/97	30	Kettle	500	17	326
4/1/97	30	Lower	600	18	197
4/3/97	30	Kettle	300	11	95
4/3/97	30	Lower	300	12	86
4/10/97	30	Kettle	100	5	20
4/10/97	30	Lower	100	5	20
4/17/97	30	Kettle	100	1	80
4/17/97	30	Lower	100	1	86
4/20/97	30	Kettle	10	1	31
4/20/97	30	Lower	10	1	40
4/24/97	30	Kettle	100	3	53
4/24/97	30	Lower	100	2	55
4/27/97	30	Kettle	100	3	93
4/27/97	30	Lower	200	3	74
5/1/97	30	Kettle	30	4	2
5/1/97	30	Lower	40	3	28
5/4/97	30	Kettle	30	2	56
5/4/97	30	Lower	30	3	38
5/8/97	30	Kettle	20	2	10
5/8/97	30	Lower	20	2	1
5/11/97	30	Kettle	30	3	144
5/11/97	30	Lower	30	3	131
5/15/97	30	Kettle	40	3	137
5/15/97	30	Lower	20	3	113
5/18/97	30	Kettle	30	3	96
5/18/97	30	Lower	30	3	93
5/22/97	30	Kettle	30	2	143
5/22/97	30	Lower	30	2	98

Organic Pond 64 physical and chemical data.

Date	Pond	Site	NO3 µg/L	NO2 µg/L	NH4 µg/L
4/1/97	64	Kettle	500	13	268
4/1/97	64	Lower	500	14	160
4/3/97	64	Kettle	300	9	107
4/3/97	64	Lower	400	8	146
4/10/97	64	Kettle	200	4	10
4/10/97	64	Lower	200	4	10
4/17/97	64	Kettle	100	1	0
4/17/97	64	Lower	100	1	0
4/20/97	64	Kettle	10	1	74
4/20/97	64	Lower	40	1	62
4/24/97	64	Kettle	200	3	65
4/24/97	64	Lower	200	3	65
4/27/97	64	Kettle	100	3	112
4/27/97	64	Lower	100	3	89
5/1/97	64	Kettle	50	5	122
5/1/97	64	Lower	40	5	184
5/4/97	64	Kettle	20	3	33
5/4/97	64	Lower	20	3	28
5/8/97	64	Kettle	20	4	0
5/8/97	64	Lower	30	4	31
5/11/97	64	Kettle	40	5	151
5/11/97	64	Lower	30	5	108
5/15/97	64	Kettle	40	3	160
5/15/97	64	Lower	40	4	132
5/18/97	64	Kettle	40	3	98
5/18/97	64	Lower	40	3	119
5/22/97	64	Kettle	40	3	156
5/22/97	64	Lower	40	2	139

Inorganic Pond 72 physical and chemical data.

Date	Pond	Site	NO3 μg/L	NO2 μg/L	NH4 μg/L
4/10/97	72	Kettle	500	7	150
4/10/97	72	Lower	500	4	150
4/17/97	72	Kettle	100	6	14
4/17/97	72	Lower	100	5	50
4/20/97	72	Kettle	120	2	28
4/20/97	72	Lower	160	1	35
4/24/97	72	Kettle	100	5	0
4/24/97	72	Lower	100	1	0
4/27/97	72	Kettle	100	4	76
4/27/97	72	Lower	100	6	65
5/1/97	72	Kettle	100	6	0
5/1/97	72	Lower	100	5	0
5/4/97	72	Kettle	110	6	26
5/4/97	72	Lower	110	6	41
5/8/97	72	Kettle	40	3	5
5/8/97	72	Lower	40	3	6
5/11/97	72	Kettle	110	5	110
5/11/97	72	Lower	110	4	115
5/15/97	72	Kettle	90	6	38
5/15/97	72	Lower	80	5	33
5/18/97	72	Kettle	110	8	83
5/18/97	72	Lower	140	8	59
5/22/97	72	Kettle	110	12	172
5/22/97	72	Lower	110	12	180

Inorganic Pond 78 physical and chemical data.

Date	Pond	Site	NO3 µg/L	NO2 µg/L	NH4 µg/L
4/10/97	78	Kettle	600	4	68
4/10/97	78	Lower	600	6	65
4/17/97	78	Kettle	200	6	7
4/17/97	78	Lower	200	6	28
4/20/97	78	Kettle	130	1	53
4/20/97	78	Lower	130	1	67
4/24/97	78	Kettle	100	5	0
4/24/97	78	Lower	100	2	7
4/27/97	78	Kettle	100	4	67
4/27/97	78	Lower	100	5	79
5/1/97	78	Kettle	70	6	0
5/1/97	78	Lower	70	6	28
5/4/97	78	Kettle	90	7	29
5/4/97	78	Lower	100	7	26
5/8/97	78	Kettle	30	4	10
5/8/97	78	Lower	40	4	3
5/11/97	78	Kettle	100	5	93
5/11/97	78	Lower	100	5	81
5/15/97	78	Kettle	30	2	45
5/15/97	78	Lower	30	2	28
5/18/97	78	Kettle	70	4	69
5/18/97	78	Lower	60	4	93
5/22/97	78	Kettle	30	3	76
5/22/97	78	Lower	30	3	62

Inorganic Pond 19 physical and chemical data.

Date	Pond Site	Alkalinity mg/$CaCO_3$/L	Chlorophyll @ µg/L	SRP µg/L	TP µg/L	Secchi Meters
4/10/97	19 Kettle	19.2	3	4	32	0.26
4/10/97	19 Lower	19	3	4	31	0.26
4/17/97	19 Kettle	23.6	2.74	4	150	0.6
4/17/97	19 Lower	23.2	2.54	5	132	0.61
4/20/97	19 Kettle	26.3	4.31	4	84	0.76
4/20/97	19 Lower	26.9	4.94	4	100	0.78
4/24/97	19 Kettle	31.1	14	4	84	1.02
4/24/97	19 Lower	31.8	13.2	3	74	1
4/27/97	19 Kettle	31.2	2	1	134	1.15
4/27/97	19 Lower	31.6	2.6	2	110	1.45
5/1/97	19 Kettle	32.6	7.3	15	34	0.92
5/1/97	19 Lower	31	6.9	10	55	0.88
5/4/97	19 Kettle	32.2	19.1	2	91	0.94
5/4/97	19 Lower	33	20.4	2	90	0.93
5/8/97	19 Kettle	32.3	4.7	0	79	1.45
5/8/97	19 Lower	31.8	3.5	0	77	1.45
5/11/97	19 Kettle	34.9	2.82	16	123	1.45
5/11/97	19 Lower	34.5	0.8	17	123	1.45
5/15/97	19 Kettle	35.7	13	13	79	1.02
5/15/97	19 Lower	36.3	7.5	13	77	0.99
5/18/97	19 Kettle	38.8	20.3	0	62	1.07
5/18/97	19 Lower	39.9	15.2	0	40	1.08
5/22/97	19 Kettle	37.5	3.21	0	47	1.45
5/22/97	19 Lower	37.2	2.83	1	47	1.45

Organic Pond 21 physical and chemical data.

Date	Pond	Site	Alkalinity mg/$CaCO_3$/L	Chlorophyll @ µg/L	SRP µg/L	TP µg/L	Secchi Meters
4/1/97	21	Kettle	19.2	1.97	6	118	0.45
4/1/97	21	Lower	22.8	1.84	6	108	0.44
4/3/97	21	Kettle	25.9	5.8	21	194	0.46
4/3/97	21	Lower	26.9	6	21	222	0.45
4/10/97	21	Kettle	37.9	6.3	0	190	0.69
4/10/97	21	Lower	38.1	3.6	0	170	0.68
4/17/97	21	Kettle	43.4	5.63	3	226	0.92
4/17/97	21	Lower	42.8	16.1	3	228	0.8
4/20/97	21	Kettle	59.6	14.7	1	180	0.87
4/20/97	21	Lower	60.1	7.08	0	202	0.76
4/24/97	21	Kettle	62.1	26	2	182	0.59
4/24/97	21	Lower	64.6	48.2	2	196	0.57
4/27/97	21	Kettle	68.4	9.8	1	200	0.61
4/27/97	21	Lower	68.4	26.5	0	214	0.55
5/1/97	21	Kettle	55.8	28.8	10	83	0.43
5/1/97	21	Lower	67.3	26.5	13	179	0.41
5/4/97	21	Kettle	72.4	51.4	3	181	0.5
5/4/97	21	Lower	73.1	26	4	200	0.54
5/8/97	21	Kettle	56.6	30.2	3	147	0.66
5/8/97	21	Lower	54.3	31.6	3	151	0.64
5/11/97	21	Kettle	67.1	24.4	7	189	0.4
5/11/97	21	Lower	67.4	28.7	8	149	0.42
5/15/97	21	Kettle	68.4	29.5	22	308	0.47
5/15/97	21	Lower	72.4	42	30	296	0.42
5/18/97	21	Kettle	77.7	39.5	4	183	0.48
5/18/97	21	Lower	79.9	12.2	4	62	0.47
5/22/97	21	Kettle	74	31.8	1	89	0.49
5/22/97	21	Lower	72.8	19.82	2	162	0.5

Organic Pond 30 physical and chemical data.

Date	Pond Site	Alkalinity mg/$CaCO_3$/L	Chlorophyll @ µg/L	SRP µg/L	TP µg/L	Secchi Meters
4/1/97	30 Kettle	19.8	2.42	6	188	0.32
4/1/97	30 Lower	19.7	2.6	12	260	0.3
4/3/97	30 Kettle	22.4	3.7	24	218	0.38
4/3/97	30 Lower	22.8	3.5	21	220	0.32
4/10/97	30 Kettle	33.2	5.1	7	164	0.82
4/10/97	30 Lower	33	6.2	7	146	0.8
4/17/97	30 Kettle	35.4	15.6	3	276	0.9
4/17/97	30 Lower	41.5	14.4	3	206	0.78
4/20/97	30 Kettle	46.2	9.28	2	178	0.78
4/20/97	30 Lower	46.8	7.36	1	238	0.87
4/24/97	30 Kettle	48.4	33.4	8	200	0.84
4/24/97	30 Lower	50	25.9	8	198	0.87
4/27/97	30 Kettle	45	8.3	4	148	1.03
4/27/97	30 Lower	58.4	1.4	4	212	1.01
5/1/97	30 Kettle	66	30.6	12	200	0.69
5/1/97	30 Lower	59.1	24.7	11	142	0.71
5/4/97	30 Kettle	62.8	25.4	2	109	0.74
5/4/97	30 Lower	64.1	14.4	4	119	0.75
5/8/97	30 Kettle	75.8	26	2	102	0.72
5/8/97	30 Lower	72.8	36.6	1	110	0.67
5/11/97	30 Kettle	80.7	5.02	4	149	0.97
5/11/97	30 Lower	79.4	9.21	5	145	0.92
5/15/97	30 Kettle	83.2	12.1	23	192	0.71
5/15/97	30 Lower	84.2	4.78	22	138	0.69
5/18/97	30 Kettle	86.3	7.86	2	79	0.93
5/18/97	30 Lower	76.1	5.63	2	79	0.92
5/22/97	30 Kettle	91	11.2	1	126	0.65
5/22/97	30 Lower	92.3	19.1	2	109	0.63

Organic Pond 64 physical and chemical data.

Date	Pond Site	Alkalinity mg/CaCO$_3$/L	Chlorophyll @ µg/L	SRP µg/L	TP µg/L	Secchi Meters
4/1/97	64 Kettle	20.4	1.7	4	138	0.33
4/1/97	64 Lower	20.4	3.01	6	74	0.35
4/3/97	64 Kettle	24.1	3.3	27	206	0.36
4/3/97	64 Lower	24	3.2	34	270	0.43
4/10/97	64 Kettle	36.6	3.4	2	176	0.82
4/10/97	64 Lower	36.5	3.3	2	170	0.87
4/17/97	64 Kettle	44.9	6.55	5	202	0.99
4/17/97	64 Lower	43.6	15.5	4	220	0.88
4/20/97	64 Kettle	49.5	8.7	5	166	0.85
4/20/97	64 Lower	50.8	3.2	5	198	0.92
4/24/97	64 Kettle	56	25.5	12	198	1.17
4/24/97	64 Lower	58	21	12	190	1.16
4/27/97	64 Kettle	60.4	2.6	9	162	1.24
4/27/97	64 Lower	60.8	4	9	204	1.45
5/1/97	64 Kettle	64.5	15.7	62	123	1.32
5/1/97	64 Lower	68	8.5	62	168	1.45
5/4/97	64 Kettle	70.4	39.9	6	132	0.94
5/4/97	64 Lower	69.6	14.9	6	149	0.95
5/8/97	64 Kettle	60.1	41	5	93	0.8
5/8/97	64 Lower	60.4	41	34	98	0.77
5/11/97	64 Kettle	74.9	9.7	8	157	0.85
5/11/97	64 Lower	71	12.7	8	176	0.77
5/15/97	64 Kettle	82.4	18.3	25	145	0.7
5/15/97	64 Lower	82	8.8	27	147	0.65
5/18/97	64 Kettle	89.5	10.7	3	87	0.82
5/18/97	64 Lower	88.5	9.51	3	93	0.77
5/22/97	64 Kettle	87.7	7.92	5	149	0.95
5/22/97	64 Lower	88.8	17.3	4	91	0.9

Inorganic Pond 72 physical and chemical data.

Date	Pond Site	Alkalinity mg/$CaCO_3$/L	Chlorophyll @ µg/L	SRP µg/L	TP µg/L	Secchi Meters
4/10/97	72 Kettle	20.5	0.8	4	216	0.4
4/10/97	72 Lower	20.5	0.8	4	204	0.4
4/17/97	72 Kettle	24.8	6.05	6	78	0.92
4/17/97	72 Lower	24.4	2	6	98	0.99
4/20/97	72 Kettle	31	8.03	8	134	1.02
4/20/97	72 Lower	31.1	7.72	8	94	1.06
4/24/97	72 Kettle	33	6	4	98	1.34
4/24/97	72 Lower	33.2	4.8	7	126	1.05
4/27/97	72 Kettle	33	1.7	1	146	1.45
4/27/97	72 Lower	32.3	1.2	5	98	1.45
5/1/97	72 Kettle	34	4.4	14	21	1.45
5/1/97	72 Lower	34	6.2	14	57	1.45
5/4/97	72 Kettle	35.6	6.7	3	78	1.43
5/4/97	72 Lower	36.6	14.2	4	87	1.45
5/8/97	72 Kettle	37.1	4.76	1	28	1.45
5/8/97	72 Lower	38.4	4.1	1	26	1.45
5/11/97	72 Kettle	38.2	1.43	17	125	1.45
5/11/97	72 Lower	38	1.57	16	126	1.45
5/15/97	72 Kettle	37.8	4.65	8	66	1.45
5/15/97	72 Lower	41	2.14	8	64	1.45
5/18/97	72 Kettle	43.3	5.35	10	72	1.45
5/18/97	72 Lower	40.4	30.3	10	21	1.45
5/22/97	72 Kettle	45.6	0.53	7	57	1.45
5/22/97	72 Lower	46.8	1.28	8	43	1.45

Inorganic Pond 78 physical and chemical data.

Date	Pond	Site	Alkalinity mg/$CaCO_3$/L	Chlorophyll @ µg/L	SRP µg/L	TP µg/L	Secchi Meters
4/10/97	78	Kettle	19.8	1.2	7	114	0.42
4/10/97	78	Lower	19.9	1.2	7	116	0.42
4/17/97	78	Kettle	26.7	4.54	6	106	0.95
4/17/97	78	Lower	25.7	4.81	3	98	0.97
4/20/97	78	Kettle	32.6	6.9	7	162	1.01
4/20/97	78	Lower	32.8	6.11	5	160	0.97
4/24/97	78	Kettle	34.1	7.2	4	86	1.23
4/24/97	78	Lower	34.5	6.9	5	86	1.3
4/27/97	78	Kettle	36	2.1	0	126	1.35
4/27/97	78	Lower	34.8	4.7	0	94	1.45
5/1/97	78	Kettle	36.5	10.1	11	70	1.02
5/1/97	78	Lower	36.2	6.3	15	57	1.08
5/4/97	78	Kettle	38.5	9.6	5	87	1.04
5/4/97	78	Lower	37.9	8.9	5	87	1.05
5/8/97	78	Kettle	41.7	12	4	55	1.45
5/8/97	78	Lower	41.8	11.9	3	55	1.45
5/11/97	78	Kettle	42.2	4.92	15	157	1.45
5/11/97	78	Lower	42.2	2.94	14	140	1.45
5/15/97	78	Kettle	42.4	3.57	10	72	1.21
5/15/97	78	Lower	42.8	6.2	11	87	1.22
5/18/97	78	Kettle	44.6	11	10	53	1.4
5/18/97	78	Lower	44.3	6.65	12	47	1.45
5/22/97	78	Kettle	40.5	18.3	9	89	1.2
5/22/97	78	Lower	40.7	13.1	8	91	1.14

Appendix 2. Rearing pond vertical profiles of temperature, conductivity, pH, and dissolved oxygen for each site during the 1997 growing season.

Appendix 2: Hatchery pond vertical profile for each site within each pond.

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/10/97	19	0	Kettle	13.7	8.57	107	9.9
4/10/97	19	0.75	Kettle	13.5	8.63	108	9.4
4/10/97	19	1.45	Kettle	12.4	8.64	108	9.4
4/17/97	19	0	Kettle	12.8	8.65	103	9.8
4/17/97	19	0.75	Kettle	12.8	8.61	105	10.1
4/17/97	19	1.45	Kettle	12.8	8.56	110	9.5
4/20/97	19	0	Kettle	13.8		105	12.3
4/20/97	19	0.75	Kettle	12.6		106	12.2
4/20/97	19	1.45	Kettle	12.4		107	12.2
4/24/97	19	0	Kettle	15.1		119	11.6
4/24/97	19	0.75	Kettle	14.5		119	11.5
4/24/97	19	1.45	Kettle	14.2		118	11.4
4/27/97	19	0	Kettle	15.9			10.8
4/27/97	19	0.75	Kettle	15.9			10.8
4/27/97	19	1.45	Kettle	15.7			10
5/1/97	19	0	Kettle	17.8	10	154	11.9
5/1/97	19	0.75	Kettle	17.8	10	154	11.8
5/1/97	19	1.45	Kettle	17.7	10	155	9.1
5/4/97	19	0	Kettle	14.9	10.1	151	9.4
5/4/97	19	0.75	Kettle	14.9	10.08	151	9.2
5/4/97	19	1.45	Kettle	14.7	10.05	152	7.4
5/8/97	19	0	Kettle	17.8	10.16	153	10.1
5/8/97	19	0.75	Kettle	17.8	10.15	153	9.6
5/8/97	19	1.45	Kettle	17.8	10.13	153	8.2
5/11/97	19	0	Kettle	14.8	9.78	150	9.1
5/11/97	19	0.75	Kettle	14.8	9.77	150	9.1
5/11/97	19	1.45	Kettle	14.8	9.75	151	7.4
5/15/97	19	0	Kettle	16.8	10.07	155	11.8
5/15/97	19	0.75	Kettle	16.8	10.09	155	11.3
5/15/97	19	1.45	Kettle	15.8	10.12	156	10.2
5/18/97	19	0	Kettle	17.3	10.1	158	11.3
5/18/97	19	0.75	Kettle	17.2	10.07	158	11.5
5/18/97	19	1.45	Kettle	16.8	9.93	160	6.5
5/22/97	19	0	Kettle	19.7	9.69	163	7.7
5/22/97	19	0.75	Kettle	19.7	9.67	163	7.7
5/22/97	19	1.45	Kettle	19.6	9.67	163	7.4

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/10/97	19	0	Lower	13.6	8.58	107	9.9
4/10/97	19	0.75	Lower	13.5	8.62	108	9.5
4/10/97	19	1.45	Lower	12.9	8.63	108	9.4
4/17/97	19	0	Lower	12.8	8.59	102	10.4
4/17/97	19	0.75	Lower	12.8	8.56	104	10.3
4/17/97	19	1.45	Lower	12.8	8.55	110	9.8
4/20/97	19	0	Lower	14.5		110	12.6
4/20/97	19	0.75	Lower	13.8		110	12.2
4/20/97	19	1.45	Lower	13.4		108	11.9
4/24/97	19	0	Lower	15.4		119	11.4
4/24/97	19	0.75	Lower	15.3		120	11.4
4/24/97	19	1.45	Lower	15.3		119	11.6
4/27/97	19	0	Lower	15.9			10.8
4/27/97	19	0.75	Lower	15.9			10.8
4/27/97	19	1.45	Lower	15.7			9.4
5/1/97	19	0	Lower	17.8	10.03	153	11.9
5/1/97	19	0.75	Lower	17.7	10.03	154	11.3
5/1/97	19	1.45	Lower	17.7	10.03	154	10.9
5/4/97	19	0	Lower	14.7	10.12	151	9.7
5/4/97	19	0.75	Lower	14.7	10.11	151	9.6
5/4/97	19	1.45	Lower	14.6	10.1	152	8.2
5/8/97	19	0	Lower	17.8	10.16	153	10
5/8/97	19	0.75	Lower	17.8	10.15	153	9.7
5/8/97	19	1.45	Lower	17.8	10.14	153	9.2
5/11/97	19	0	Lower	14.9	9.78	150	8.9
5/11/97	19	0.75	Lower	14.9	9.75	149	8.9
5/11/97	19	1.45	Lower	14.9	9.73	147	8.6
5/15/97	19	0	Lower	17	10.04	155	11.8
5/15/97	19	0.75	Lower	17	10.05	156	11.3
5/15/97	19	1.45	Lower	17	10.06	157	11.2
5/18/97	19	0	Lower	17.5	10.12	158	11.7
5/18/97	19	0.75	Lower	17.5	10.09	159	11.5
5/18/97	19	1.45	Lower	17.3	10.03	160	4.8
5/22/97	19	0	Lower	19.6	9.66	163	7.7
5/22/97	19	0.75	Lower	19.6	9.65	163	7.5
5/22/97	19	1.45	Lower	19.4	9.61	163	6.1

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/3/97	21	0	Kettle	15.5	8.17	120	11.6
4/3/97	21	0.75	Kettle	15.5	8.27	120	11.4
4/3/97	21	1.45	Kettle	14.6	8.25	121	10.8
4/10/97	21	0	Kettle	14	8.46	145	11
4/10/97	21	0.75	Kettle	13.6	8.46	145	10.5
4/10/97	21	1.45	Kettle	12.2	8.41	143	10.2
4/17/97	21	0	Kettle	13.6	8.33	142	9.3
4/17/97	21	0.75	Kettle	13.6	8.21	140	9.3
4/17/97	21	1.45	Kettle	13.6	8.18	170	9.3
4/20/97	21	0	Kettle	14.4		148	10.4
4/20/97	21	0.75	Kettle	13.4		142	10.2
4/20/97	21	1.45	Kettle	13		139	9.8
4/24/97	21	0	Kettle	15.3		165	11.4
4/24/97	21	0.75	Kettle	14.7		161	11
4/24/97	21	1.45	Kettle	13.7		158	7.5
4/27/97	21	0	Kettle	16			10.2
4/27/97	21	0.75	Kettle	16			10.1
4/27/97	21	1.45	Kettle	14.7			0.2
5/1/97	21	0	Kettle	17.9	9.08	206	10.9
5/1/97	21	0.75	Kettle	17.6	8.95	206	10.5
5/1/97	21	1.45	Kettle	16	8.26	226	5
5/4/97	21	0	Kettle	14.8	8.48	215	7.2
5/4/97	21	0.75	Kettle	14.6	8.29	216	6.7
5/4/97	21	1.45	Kettle	14.6	8.23	217	5.2
5/8/97	21	0	Kettle	17.6	9.12	176	11.7
5/8/97	21	0.75	Kettle	17.5	9.03	176	10.7
5/8/97	21	1.45	Kettle	15.2	8.16	256	0.4
5/11/97	21	0	Kettle	15.2	9.15	193	9.9
5/11/97	21	0.75	Kettle	15.2	9.05	193	9.9
5/11/97	21	1.45	Kettle	14.2	7.92	210	2.2
5/15/97	21	0	Kettle	16.4	8.93	198	8.8
5/15/97	21	0.75	Kettle	16.4	8.76	199	8.4
5/15/97	21	1.45	Kettle	15.8	8.58	200	0.3
5/18/97	21	0	Kettle	18	7.88	212	4.9
5/18/97	21	0.75	Kettle	17.2	7.78	215	3.7
5/18/97	21	1.45	Kettle	13.9	7.65	245	0.3
5/22/97	21	0	Kettle	19.4	8.62	208	7.1
5/22/97	21	0.75	Kettle	18.6	8.72	208	7.1
5/22/97	21	1.45	Kettle	17.1	7.62	252	0.1

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/3/97	21	0	Lower	13.8	8.04	119	11.4
4/3/97	21	0.75	Lower	13.7	8.15	119	11.1
4/3/97	21	1.45	Lower	12.4	8.2	119	10.7
4/10/97	21	0	Lower	13.6	8.15	145	11.3
4/10/97	21	0.75	Lower	13.5	8.1	145	11.3
4/10/97	21	1.45	Lower	12.7	8.05	143	11.1
4/17/97	21	0	Lower	13.5	8.33	142	10.4
4/17/97	21	0.75	Lower	13.5	8.2	141	10.3
4/17/97	21	1.45	Lower	13.5	8.17	139	9.3
4/20/97	21	0	Lower	15.4		155	10.4
4/20/97	21	0.75	Lower	15.3		154	10.1
4/20/97	21	1.45	Lower	13.1		149	10.1
4/24/97	21	0	Lower	15.9		163	11.5
4/24/97	21	0.75	Lower	15.9		162	11.4
4/24/97	21	1.45	Lower	14		160	9.3
4/27/97	21	0	Lower	16			9.6
4/27/97	21	0.75	Lower	15.9			9.1
4/27/97	21	1.45	Lower	15.7			4.4
5/1/97	21	0	Lower	18	9.1	207	11.5
5/1/97	21	0.75	Lower	17.9	9.11	207	11.5
5/1/97	21	1.45	Lower	17.8	9.1	205	9.3
5/4/97	21	0	Lower	14.9	8.62	214	8
5/4/97	21	0.75	Lower	14.8	8.61	215	7.6
5/4/97	21	1.45	Lower	14.6	8.6	217	6.9
5/8/97	21	0	Lower	17.6	9.18	176	11.6
5/8/97	21	0.75	Lower	17.5	9.16	178	11.4
5/8/97	21	1.45	Lower	16.9	8.74	225	3.2
5/11/97	21	0	Lower	15	9.53	193	10.6
5/11/97	21	0.75	Lower	15	9.2	193	10.6
5/11/97	21	1.45	Lower	14.5	9.09	194	6.4
5/15/97	21	0	Lower	16.4	8.8	198	8.9
5/15/97	21	0.75	Lower	16.4	8.75	199	8.5
5/15/97	21	1.45	Lower	15.9	8.65	201	2.1
5/18/97	21	0	Lower	18	7.9	214	4.9
5/18/97	21	0.75	Lower	17.3	7.7	216	4.1
5/18/97	21	1.45	Lower	15.7	7.74	218	0.6
5/22/97	21	0	Lower	19.4	8.66	208	7.4
5/22/97	21	0.75	Lower	18.8	8.72	208	7.3
5/22/97	21	1.45	Lower	18.3	8.74	208	7.3

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/3/97	30	0	Kettle	16.3	8.19	115	8.2
4/3/97	30	0.75	Kettle	15.7	8.2	115	8.2
4/3/97	30	1.45	Kettle	11.5	8.27	112	8.3
4/10/97	30	0	Kettle	13.6	8.95	136	12.2
4/10/97	30	0.75	Kettle	13.2	8.94	135	12
4/10/97	30	1.45	Kettle	12.8	8.94	135	11
4/17/97	30	0	Kettle	13.8	9	128	12.6
4/17/97	30	0.75	Kettle	13.8	8.97	126	12.4
4/17/97	30	1.45	Kettle	13.8	8.96	125	12.1
4/20/97	30	0	Kettle	14.5		131	11.5
4/20/97	30	0.75	Kettle	14.1		130	11.5
4/20/97	30	1.45	Kettle	13.8		122	11.6
4/24/97	30	0	Kettle	16.4		149	9.9
4/24/97	30	0.75	Kettle	16.3		149	9.8
4/24/97	30	1.45	Kettle	15.6		148	9.6
4/27/97	30	0	Kettle	16.1			7.5
4/27/97	30	0.75	Kettle	16.1			7.5
4/27/97	30	1.45	Kettle	15.6			1.9
5/1/97	30	0	Kettle	18.2	9.12	196	11.3
5/1/97	30	0.75	Kettle	18.2	9.09	196	11.2
5/1/97	30	1.45	Kettle	18.2	9.06	195	10.5
5/4/97	30	0	Kettle	15.1	8.12	206	6.6
5/4/97	30	0.75	Kettle	15.1	8.12	206	6.5
5/4/97	30	1.45	Kettle	15.1	8.13	207	5.8
5/8/97	30	0	Kettle	18	7.98	224	6.3
5/8/97	30	0.75	Kettle	17.8	7.86	225	4.8
5/8/97	30	1.45	Kettle	17.6	7.94	227	3.4
5/11/97	30	0	Kettle	15.6	7.96	229	6.5
5/11/97	30	0.75	Kettle	15.1	7.96	229	6.5
5/11/97	30	1.45	Kettle	15	7.95	229	6.3
5/15/97	30	0	Kettle	16.5	8.36	230	9.2
5/15/97	30	0.75	Kettle	16.5	8.36	230	8.9
5/15/97	30	1.45	Kettle	16.5	8.35	232	7.1
5/18/97	30	0	Kettle	18.1	8.14	239	7.3
5/18/97	30	0.75	Kettle	17.9	8.1	239	7.2
5/18/97	30	1.45	Kettle	17.7	8.1	238	6
5/22/97	30	0	Kettle	19.9	8.78	241	8.8
5/22/97	30	0.75	Kettle	19.5	8.77	239	8.4
5/22/97	30	1.45	Kettle	19.3	8.73	239	7.3

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/3/97	30	0	Lower	14.6	8.16	115	8.2
4/3/97	30	0.75	Lower	14.4	8.17	115	8.2
4/3/97	30	1.45	Lower	11.8	8.22	112	8.2
4/10/97	30	0	Lower	14	8.81	136	11.6
4/10/97	30	0.75	Lower	13.8	8.79	136	11.9
4/10/97	30	1.45	Lower	13.1	8.77	136	11.3
4/17/97	30	0	Lower	13.7	8.83	129	12.3
4/17/97	30	0.75	Lower	13.7	8.81	128	12.4
4/17/97	30	1.45	Lower	13.6	8.81	125	11.3
4/20/97	30	0	Lower	15.9		138	11.5
4/20/97	30	0.75	Lower	15.2		131	11.5
4/20/97	30	1.45	Lower	13.6		130	12.5
4/24/97	30	0	Lower	16		151	9.9
4/24/97	30	0.75	Lower	16		151	10
4/24/97	30	1.45	Lower	15.6		151	10
4/27/97	30	0	Lower	16.2			8.1
4/27/97	30	0.75	Lower	16.2			8.2
4/27/97	30	1.45	Lower	16.1			7.3
5/1/97	30	0	Lower	18.3	9.12	192	11.2
5/1/97	30	0.75	Lower	18.2	9.09	196	11.2
5/1/97	30	1.45	Lower	18.2	9.08	196	9.5
5/4/97	30	0	Lower	15.1	8.06	206	6.6
5/4/97	30	0.75	Lower	15.1	8.06	206	6.4
5/4/97	30	1.45	Lower	15.1	8.06	207	5.8
5/8/97	30	0	Lower	18	8.17	221	6.9
5/8/97	30	0.75	Lower	18	8.19	223	6.8
5/8/97	30	1.45	Lower	17.9	8.25	221	6
5/11/97	30	0	Lower	15.6	7.94	229	6.5
5/11/97	30	0.75	Lower	15.1	7.95	228	6.5
5/11/97	30	1.45	Lower	14.7	7.95	228	5.8
5/15/97	30	0	Lower	16.5	8.36	230	9.2
5/15/97	30	0.75	Lower	16.5	8.36	231	8.9
5/15/97	30	1.45	Lower	16.4	8.36	232	7
5/18/97	30	0	Lower	17.9	8.1	239	7.3
5/18/97	30	0.75	Lower	17.8	8.07	239	7.3
5/18/97	30	1.45	Lower	17.5	8.06	239	6
5/22/97	30	0	Lower	20	8.79	241	8.5
5/22/97	30	0.75	Lower	19.6	8.79	237	8.2
5/22/97	30	1.45	Lower	19	8.76	237	7.6

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity µs cm^{-1}	D.O. ppm
4/3/97	64	0	Kettle	16.6	8.12	122	8.1
4/3/97	64	0.75	Kettle	16.4	8.19	121	8.2
4/3/97	64	1.45	Kettle	12.1	8.22	120	8.2
4/10/97	64	0	Kettle	13.5	8.6	148	11.4
4/10/97	64	0.75	Kettle	13.3	8.58	148	11.3
4/10/97	64	1.45	Kettle	12.5	8.56	147	11.8
4/17/97	64	0	Kettle	13.5	8.73	132	10
4/17/97	64	0.75	Kettle	13.5	8.71	132	11.3
4/17/97	64	1.45	Kettle	13.5	8.7	131	11.7
4/20/97	64	0	Kettle	16.1		152	9.9
4/20/97	64	0.75	Kettle	15.7		151	9.9
4/20/97	64	1.45	Kettle	13.7		142	9.9
4/24/97	64	0	Kettle	16.4		183	9.3
4/24/97	64	0.75	Kettle	16.4		182	9.3
4/24/97	64	1.45	Kettle	15.9		181	8.9
4/27/97	64	0	Kettle	16.2			7.3
4/27/97	64	0.75	Kettle	16.1			7.2
4/27/97	64	1.45	Kettle	15.5			1.1
5/1/97	64	0	Kettle	18.3	8.2	215	8
5/1/97	64	0.75	Kettle	18.3	8.21	216	8
5/1/97	64	1.45	Kettle	18.3	8.25	217	7.4
5/4/97	64	0	Kettle	15.3	8.37	220	7.8
5/4/97	64	0.75	Kettle	15.3	8.4	220	7.7
5/4/97	64	1.45	Kettle	15.3	8.51	220	6
5/8/97	64	0	Kettle	18.2	9.07	192	10.8
5/8/97	64	0.75	Kettle	18.1	8.97	195	8.9
5/8/97	64	1.45	Kettle	17.2	8.21	231	0.2
5/11/97	64	0	Kettle	15.2	8.01	217	5.4
5/11/97	64	0.75	Kettle	14.9	8.02	217	5.3
5/11/97	64	1.45	Kettle	14.8	8.02	217	4.9
5/15/97	64	0	Kettle	17.1	8.75	223	9.9
5/15/97	64	0.75	Kettle	17.1	8.74	225	9.4
5/15/97	64	1.45	Kettle	17	8.74	232	9
5/18/97	64	0	Kettle	17.9	8.01	238	6.4
5/18/97	64	0.75	Kettle	17.8	7.93	238	6.2
5/18/97	64	1.45	Kettle	15.8	7.62	254	0.9
5/22/97	64	0	Kettle	19.8	8.09	246	6.5
5/22/97	64	0.75	Kettle	19.3	8.09	243	6.2
5/22/97	64	1.45	Kettle	19.3	8.09	243	5.6

Date	Pond	Depth Site Meters	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/3/97	64	0 Lower	15.2	8.24	121	8.2
4/3/97	64	0.75 Lower	15.1	8.28	121	8.3
4/3/97	64	1.45 Lower	12.7	8.24	123	8.3
4/10/97	64	0 Lower	14.6	8.67	149	11.2
4/10/97	64	0.75 Lower	14.5	8.69	148	11.1
4/10/97	64	1.45 Lower	13.3	8.69	147	11.7
4/17/97	64	0 Lower	13.5	8.7	132	10.1
4/17/97	64	0.75 Lower	13.5	8.7	132	11.3
4/17/97	64	1.45 Lower	13.5	8.69	131	11.7
4/20/97	64	0 Lower	15.9		152	10
4/20/97	64	0.75 Lower	15.9		151	9.9
4/20/97	64	1.45 Lower	13.8		145	10.5
4/24/97	64	0 Lower	16.2		183	9.3
4/24/97	64	0.75 Lower	16.2		182	9.3
4/24/97	64	1.45 Lower	15.8		180	9.1
4/27/97	64	0 Lower	16.2			7.3
4/27/97	64	0.75 Lower	16.1			7.3
4/27/97	64	1.45 Lower	16.1			6.1
5/1/97	64	0 Lower	18.3	8.1	217	8.3
5/1/97	64	0.75 Lower	18.3	8.11	218	8
5/1/97	64	1.45 Lower	18.3	8.13	218	7.9
5/4/97	64	0 Lower	15.3	8.21	220	7.6
5/4/97	64	0.75 Lower	15.3	8.21	220	7.5
5/4/97	64	1.45 Lower	15.3	8.27	220	6.7
5/8/97	64	0 Lower	18.2	9.08	193	11
5/8/97	64	0.75 Lower	18.1	8.95	194	9.3
5/8/97	64	1.45 Lower	17.2	8.22	232	0.8
5/11/97	64	0 Lower	15.5	8.14	216	6.3
5/11/97	64	0.75 Lower	15	8.17	216	5.8
5/11/97	64	1.45 Lower	14.5	8.32	219	5.2
5/15/97	64	0 Lower	17.2	8.74	224	9.9
5/15/97	64	0.75 Lower	17.1	8.74	225	9.3
5/15/97	64	1.45 Lower	17.1	8.74	227	9.1
5/18/97	64	0 Lower	17.7	8.12	238	6.2
5/18/97	64	0.75 Lower	17.6	8.13	238	6
5/18/97	64	1.45 Lower	17.4	8.14	238	3.8
5/22/97	64	0 Lower	19.8	8.12	243	6.5
5/22/97	64	0.75 Lower	19.7	8.17	242	6.4
5/22/97	64	1.45 Lower	18.9	8.27	242	6.4

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/10/97	72	0	Kettle	14.5	8.42	113	10.1
4/10/97	72	0.75	Kettle	14.1	8.53	112	9.7
4/10/97	72	1.45	Kettle	10.2	8.59	111	9.9
4/17/97	72	0	Kettle	13.5	8.45	109	12.2
4/17/97	72	0.75	Kettle	13.5	8.44	110	11.8
4/17/97	72	1.45	Kettle	13.4	8.43	110	11.8
4/20/97	72	0	Kettle	15.9		119	12.5
4/20/97	72	0.75	Kettle	14.6		118	13.1
4/20/97	72	1.45	Kettle	13.8		115	13.5
4/24/97	72	0	Kettle	15.6		129	11.5
4/24/97	72	0.75	Kettle	15.2		128	11.7
4/24/97	72	1.45	Kettle	15		128	12.1
4/27/97	72	0	Kettle	16.2			10.5
4/27/97	72	0.75	Kettle	16.2			10.5
4/27/97	72	1.45	Kettle	16.2			10.5
5/1/97	72	0	Kettle	18.6	9.8	156	11.3
5/1/97	72	0.75	Kettle	18.6	9.8	156	11.4
5/1/97	72	1.45	Kettle	18.6	9.81	156	9.6
5/4/97	72	0	Kettle	15.6	10.05	158	10.5
5/4/97	72	0.75	Kettle	15.6	10.05	158	10.4
5/4/97	72	1.45	Kettle	15.5	10.07	157	10.2
5/8/97	72	0	Kettle	18.6	10.24	160	11.5
5/8/97	72	0.75	Kettle	18.5	10.23	160	11.4
5/8/97	72	1.45	Kettle	18.5	10.21	161	9.1
5/11/97	72	0	Kettle	15.3	10.01	159	10.3
5/11/97	72	0.75	Kettle	15.3	10	159	10.3
5/11/97	72	1.45	Kettle	15.3	9.99	159	9
5/15/97	72	0	Kettle	17.8	10.12	161	12
5/15/97	72	0.75	Kettle	17.8	10.12	163	11.9
5/15/97	72	1.45	Kettle	17.7	10.13	165	10.3
5/18/97	72	0	Kettle	17.8	9.99	165	9.2
5/18/97	72	0.75	Kettle	17.8	9.92	166	9.4
5/18/97	72	1.45	Kettle	17.3	9.56	178	4.3
5/22/97	72	0	Kettle	20.1	9.46	173	5.5
5/22/97	72	0.75	Kettle	20	9.44	173	5.4
5/22/97	72	1.45	Kettle	19.7	9.39	175	4.5

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity µs cm⁻¹	D.O. ppm
4/10/97	72	0	Lower	14.5	8.4	113	10.1
4/10/97	72	0.75	Lower	14.1	8.51	113	9.8
4/10/97	72	1.45	Lower	11.2	8.57	112	9.9
4/17/97	72	0	Lower	13.5	8.44	109	12.2
4/17/97	72	0.75	Lower	13.5	8.43	110	11.8
4/17/97	72	1.45	Lower	13.5	8.43	110	11.8
4/20/97	72	0	Lower	15.5		121	12.5
4/20/97	72	0.75	Lower	14.4		119	13.5
4/20/97	72	1.45	Lower	14.1		117	13.6
4/24/97	72	0	Lower	15.9		129	11.3
4/24/97	72	0.75	Lower	15.9		129	11.3
4/24/97	72	1.45	Lower	15.6		128	11.7
4/27/97	72	0	Lower	16.2			10.5
4/27/97	72	0.75	Lower	16.2			10.5
4/27/97	72	1.45	Lower	16.1			10.4
5/1/97	72	0	Lower	18.6	9.8	157	11.3
5/1/97	72	0.75	Lower	18.5	9.79	156	11.2
5/1/97	72	1.45	Lower	18.5	9.8	156	9.9
5/4/97	72	0	Lower	15.7	10.04	157	10.5
5/4/97	72	0.75	Lower	15.7	10.04	156	10.2
5/4/97	72	1.45	Lower	15.7	10.04	157	9.4
5/8/97	72	0	Lower	18.6	10.24	162	11.4
5/8/97	72	0.75	Lower	18.5	10.23	162	11.3
5/8/97	72	1.45	Lower	18.5	10.23	163	9.2
5/11/97	72	0	Lower	15.3	10.01	159	10.3
5/11/97	72	0.75	Lower	15.3	10	159	10.2
5/11/97	72	1.45	Lower	15.3	9.99	157	9.1
5/15/97	72	0	Lower	17.7	10.14	160	12
5/15/97	72	0.75	Lower	17.7	10.14	160	11.9
5/15/97	72	1.45	Lower	17.7	10.15	162	10.3
5/18/97	72	0	Lower	17.9	10.03	165	10.5
5/18/97	72	0.75	Lower	17.9	10.01	164	10.6
5/18/97	72	1.45	Lower	17.8	10.01	164	9.8
5/22/97	72	0	Lower	20.1	9.47	173	5.7
5/22/97	72	0.75	Lower	20	9.46	173	5.4
5/22/97	72	1.45	Lower	19.4	9.4	174	4.5

Date	Pond	Depth Site Meters		Temperature Celsius	pH	Conductivity µs cm^{-1}	D.O. ppm
4/10/97	78	0	Kettle	12	8.2	110	9.9
4/10/97	78	0.75	Kettle	10.9	8.21	109	9.3
4/10/97	78	1.45	Kettle	9.9	8.19	109	9.5
4/17/97	78	0	Kettle	13.6	8.23	118	11.9
4/17/97	78	0.75	Kettle	13.6	8.22	111	11.8
4/17/97	78	1.45	Kettle	13.5	8.2	114	11.4
4/20/97	78	0	Kettle	16.7		122	12.4
4/20/97	78	0.75	Kettle	16.4		121	12.4
4/20/97	78	1.45	Kettle	13.6		111	13.2
4/24/97	78	0	Kettle	16.6		132	11.2
4/24/97	78	0.75	Kettle	16.4		131	11.3
4/24/97	78	1.45	Kettle	15.2		131	12.5
4/27/97	78	0	Kettle	16.2			10.7
4/27/97	78	0.75	Kettle	16.2			10.7
4/27/97	78	1.45	Kettle	16.1			9.8
5/1/97	78	0	Kettle	18.5	9.84	153	12
5/1/97	78	0.75	Kettle	18.5	9.85	154	12
5/1/97	78	1.45	Kettle	18.5	9.85	154	10.4
5/4/97	78	0	Kettle	16.1	9.95	153	10.4
5/4/97	78	0.75	Kettle	16.1	9.94	153	10.2
5/4/97	78	1.45	Kettle	16	9.93	150	9.2
5/8/97	78	0	Kettle	18.7	10.01	156	10.7
5/8/97	78	0.75	Kettle	18.7	9.97	156	10.6
5/8/97	78	1.45	Kettle	18.6	9.92	153	8.7
5/11/97	78	0	Kettle	16.2	9.86	157	9.2
5/11/97	78	0.75	Kettle	16.1	9.85	157	8.9
5/11/97	78	1.45	Kettle	16.1	9.84	157	8.5
5/15/97	78	0	Kettle	18.3	10.34	159	12.3
5/15/97	78	0.75	Kettle	18.3	10.34	160	12.2
5/15/97	78	1.45	Kettle	18.2	10.28	161	11.4
5/18/97	78	0	Kettle	18	10.11	156	11.7
5/18/97	78	0.75	Kettle	17.9	10.07	156	11.7
5/18/97	78	1.45	Kettle	17.8	9.64	168	5.7
5/22/97	78	0	Kettle	20.3	9.97	152	9.2
5/22/97	78	0.75	Kettle	20.3	9.96	152	9.5
5/22/97	78	1.45	Kettle	19.4	9.19	174	1.6

Date	Pond	Depth Meters	Site	Temperature Celsius	pH	Conductivity $\mu s\ cm^{-1}$	D.O. ppm
4/10/97	78	0	Lower	12.1	8.2	110	9.9
4/10/97	78	0.75	Lower	11	8.19	109	9.3
4/10/97	78	1.45	Lower	10.1	8.19	109	9.5
4/17/97	78	0	Lower	13.6	8.23	118	11.9
4/17/97	78	0.75	Lower	13.6	8.21	115	11.8
4/17/97	78	1.45	Lower	13.5	8.19	111	11.4
4/20/97	78	0	Lower	16.7		119	12.5
4/20/97	78	0.75	Lower	15.4		118	13.1
4/20/97	78	1.45	Lower	13.8		112	14.1
4/24/97	78	0	Lower	16.4		130	11.2
4/24/97	78	0.75	Lower	16.2		128	11.2
4/24/97	78	1.45	Lower	15.2		127	12.5
4/27/97	78	0	Lower	16.2			10.8
4/27/97	78	0.75	Lower	16.2			10.8
4/27/97	78	1.45	Lower	16.2			10.4
5/1/97	78	0	Lower	18.5	9.82	153	12
5/1/97	78	0.75	Lower	18.5	9.85	153	12
5/1/97	78	1.45	Lower	18.5	9.86	154	11.5
5/4/97	78	0	Lower	16.2	9.95	153	10.5
5/4/97	78	0.75	Lower	16.2	9.93	153	10.3
5/4/97	78	1.45	Lower	16.2	9.93	153	8.4
5/8/97	78	0	Lower	18.7	9.96	157	10.6
5/8/97	78	0.75	Lower	18.7	9.96	157	10.6
5/8/97	78	1.45	Lower	18.6	9.94	155	8.5
5/11/97	78	0	Lower	16.2	9.88	157	10
5/11/97	78	0.75	Lower	16.1	9.88	157	9.9
5/11/97	78	1.45	Lower	15.8	9.88	155	9.9
5/15/97	78	0	Lower	18.3	10.34	158	12.3
5/15/97	78	0.75	Lower	18.3	10.31	159	12.2
5/15/97	78	1.45	Lower	18.3	10.3	160	12
5/18/97	78	0	Lower	18	10.1	156	11.5
5/18/97	78	0.75	Lower	17.9	10.09	156	11.4
5/18/97	78	1.45	Lower	17.9	10.07	156	9.8
5/22/97	78	0	Lower	20.4	9.95	152	8.7
5/22/97	78	0.75	Lower	20.4	9.92	152	9.2
5/22/97	78	1.45	Lower	19.9	9.88	151	8.4

Appendix 3. Diel Dissolved Oxygen profiles for each rearing pond for the 1997 growing season.

Dissolved oxygen profile for pond 19.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/15/97	0	10.6	4/15/97	0	11.3
4/15/97	0.75	11.6	4/15/97	0.75	11.8
4/15/97	1.45	15.7	4/15/97	1.45	11.9
4/16/97	0	10.4	4/16/97	0	11.2
4/16/97	0.75	10.8	4/16/97	0.75	12.4
4/16/97	1.45	10.5	4/16/97	1.45	12.8
4/17/97	0	10.4	4/17/97	0	11.0
4/17/97	0.75	10.6	4/17/97	0.75	11.8
4/17/97	1.45	10.2	4/17/97	1.45	11.9
4/18/97	0	12.3	4/18/97	0	11.0
4/18/97	0.75	12.6	4/18/97	0.75	11.4
4/18/97	1.45	12.8	4/18/97	1.45	11.6
4/19/97	0	11.3	4/19/97	0	12.7
4/19/97	0.75	11.4	4/19/97	0.75	12.7
4/19/97	1.45	11.6	4/19/97	1.45	11.2
4/20/97	0	11.5	4/20/97	0	12.7
4/20/97	0.75	11.4	4/20/97	0.75	12.7
4/20/97	1.45	11.4	4/20/97	1.45	11.9
4/21/97	0	11.6	4/21/97	0	12.6
4/21/97	0.75	11.8	4/21/97	0.75	12.6
4/21/97	1.45	12.8	4/21/97	1.45	12.8
4/22/97	0	12.4	4/22/97	0	12.5
4/22/97	0.75	12.4	4/22/97	0.75	12.5
4/22/97	1.45	12.3	4/22/97	1.45	13.8
4/23/97	0	11.5	4/23/97	0	12.3
4/23/97	0.75	11.5	4/23/97	0.75	12.2
4/23/97	1.45	11.3	4/23/97	1.45	10.1
4/24/97	0	11.4	4/24/97	0	11.7
4/24/97	0.75	11.5	4/24/97	0.75	11.7
4/24/97	1.45	10.9	4/24/97	1.45	12.6
4/25/97	0	10.3	4/25/97	0	11.6
4/25/97	0.75	10.3	4/25/97	0.75	11.6
4/25/97	1.45	10.2	4/25/97	1.45	12.2
4/26/97	0	10.8	4/26/97	0	11.9
4/26/97	0.75	10.8	4/26/97	0.75	11.9
4/26/97	1.45	10.9	4/26/97	1.45	12.8
4/27/97	0	10.7	4/27/97	0	10.8
4/27/97	0.75	10.6	4/27/97	0.75	10.8
4/27/97	1.45	12.5	4/27/97	1.45	10.0
4/28/97	0	10.3	4/28/97	0	11.7
4/28/97	0.75	10.0	4/28/97	0.75	11.7
4/28/97	1.45	8.3	4/28/97	1.45	11.6

Dissolved oxygen profile for pond 19.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/29/97	0	10.6	4/29/97	0	11.9
4/29/97	0.75	10.5	4/29/97	0.75	11.9
4/29/97	1.45	10.5	4/29/97	1.45	12.8
4/30/97	0	11.8	4/30/97	0	13.4
4/30/97	0.75	12.0	4/30/97	0.75	13.4
4/30/97	1.45	12.8	4/30/97	1.45	14.4
5/1/97	0	10.2	5/1/97	0	11.9
5/1/97	0.75	10.2	5/1/97	0.75	11.8
5/1/97	1.45	10.7	5/1/97	1.45	9.1
5/2/97	0	10.1	5/2/97	0	12.5
5/2/97	0.75	10.0	5/2/97	0.75	12.5
5/2/97	1.45	10.0	5/2/97	1.45	12.5
5/3/97	0	9.5	5/3/97	0	11.1
5/3/97	0.75	9.4	5/3/97	0.75	11.1
5/3/97	1.45	9.4	5/3/97	1.45	10.9
5/4/97	0	8.8	5/4/97	0	13.6
5/4/97	0.75	8.8	5/4/97	0.75	13.6
5/4/97	1.45	8.8	5/4/97	1.45	14.0
5/5/97	0	11	5/5/97	0	13.8
5/5/97	0.75	11.0	5/5/97	0.75	13.8
5/5/97	1.45	10.9	5/5/97	1.45	13.7
5/6/97	0	9.9	5/6/97	0	13.4
5/6/97	0.75	9.8	5/6/97	0.75	13.4
5/6/97	1.45	9.8	5/6/97	1.45	14.5
5/7/97	0	10.6	5/7/97	0	11.6
5/7/97	0.75	10.5	5/7/97	0.75	13.2
5/7/97	1.45	9.9	5/7/97	1.45	13.2
5/8/97	0	9.2	5/8/97	0	10.1
5/8/97	0.75	9.2	5/8/97	0.75	9.6
5/8/97	1.45	9.2	5/8/97	1.45	8.2
5/9/97	0	8.6	5/9/97	0	10.6
5/9/97	0.75	8.6	5/9/97	0.75	10.5
5/9/97	1.45	8.6	5/9/97	1.45	9.5
5/10/97	0	8.3	5/10/97	0	11.1
5/10/97	0.75	8.4	5/10/97	0.75	11.0
5/10/97	1.45	8.4	5/10/97	1.45	10.9
5/11/97	0	9	5/11/97	0	11.7
5/11/97	0.75	9.0	5/11/97	0.75	11.6
5/11/97	1.45	9.0	5/11/97	1.45	11.5
5/12/97	0	9.9	5/12/97	0	10.5
5/12/97	0.75	9.8	5/12/97	0.75	10.5
5/12/97	1.45	9.7	5/12/97	1.45	10.5

Dissolved oxygen profile for pond 19.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
5/13/97	0	9.1	5/13/97	0	11.7
5/13/97	0.75	9.1	5/13/97	0.75	11.7
5/13/97	1.45	9.2	5/13/97	1.45	11.6
5/14/97	0	10.3	5/14/97	0	13.6
5/14/97	0.75	10.3	5/14/97	0.75	13.6
5/14/97	1.45	10.2	5/14/97	1.45	13.3
5/15/97	0	10.2	5/15/97	0	11.8
5/15/97	0.75	10.2	5/15/97	0.75	11.3
5/15/97	1.45	10.2	5/15/97	1.45	10.2
5/16/97	0	9.7	5/16/97	0	12.9
5/16/97	0.75	9.7	5/16/97	0.75	12.9
5/16/97	1.45	9.5	5/16/97	1.45	14.0
5/17/97	0	11	5/17/97	0	13.3
5/17/97	0.75	11.0	5/17/97	0.75	13.4
5/17/97	1.45	11.0	5/17/97	1.45	13.7
5/18/97	0	11.6	5/18/97	0	15.8
5/18/97	0.75	11.0	5/18/97	0.75	16.2
5/18/97	1.45	3.7	5/18/97	1.45	15.4
5/19/97	0	10.6	5/19/97	0	11.3
5/19/97	0.75	10.6	5/19/97	0.75	11.3
5/19/97	1.45	2.2	5/19/97	1.45	9.0
5/20/97	0	8.3	5/20/97	0	11.0
5/20/97	0.75	8.1	5/20/97	0.75	11.0
5/20/97	1.45	0.7	5/20/97	1.45	8.7
5/21/97	0	8.2	5/21/97	0	9.3
5/21/97	0.75	8.1	5/21/97	0.75	9.3
5/21/97	1.45	6.5	5/21/97	1.45	9.1
5/22/97	0	7.1	5/22/97	0	8.3
5/22/97	0.75	7.1	5/22/97	0.75	8.2
5/22/97	1.45	6.9	5/22/97	1.45	7.4

Dissolved oxygen profile for pond 21.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/15/97	0	9.0	4/15/97	0	10.2
4/15/97	0.75	9.2	4/15/97	0.75	10.2
4/15/97	1.45	6.0	4/15/97	1.45	7.6
4/16/97	0	8.2	4/16/97	0	10.9
4/16/97	0.75	8.1	4/16/97	0.75	11.0
4/16/97	1.45	7.2	4/16/97	1.45	11.2
4/17/97	0	7.8	4/17/97	0	10.9
4/17/97	0.75	7.9	4/17/97	0.75	11.0
4/17/97	1.45	1.5	4/17/97	1.45	11.3
4/18/97	0	9.9	4/18/97	0	10.9
4/18/97	0.75	10.1	4/18/97	0.75	11.0
4/18/97	1.45	10.2	4/18/97	1.45	11.6
4/19/97	0	9.0	4/19/97	0	12.3
4/19/97	0.75	9.0	4/19/97	0.75	11.8
4/19/97	1.45	9.1	4/19/97	1.45	8.0
4/20/97	0	8.3	4/20/97	0	11.8
4/20/97	0.75	7.7	4/20/97	0.75	11.6
4/20/97	1.45	7.3	4/20/97	1.45	8.3
4/21/97	0	9.3	4/21/97	0	11.5
4/21/97	0.75	9.2	4/21/97	0.75	11.7
4/21/97	1.45	9.7	4/21/97	1.45	8.5
4/22/97	0	8.3	4/22/97	0	11.3
4/22/97	0.75	8.2	4/22/97	0.75	11.8
4/22/97	1.45	6.0	4/22/97	1.45	9.8
4/23/97	0	8.7	4/23/97	0	10.9
4/23/97	0.75	8.6	4/23/97	0.75	10.9
4/23/97	1.45	5.8	4/23/97	1.45	0.3
4/24/97	0	8.0	4/24/97	0	12.7
4/24/97	0.75	8.0	4/24/97	0.75	12.4
4/24/97	1.45	7.9	4/24/97	1.45	8.9
4/25/97	0	8.9	4/25/97	0	13.8
4/25/97	0.75	8.1	4/25/97	0.75	13.3
4/25/97	1.45	2.0	4/25/97	1.45	6.3
4/26/97	0	9.8	4/26/97	0	12.5
4/26/97	0.75	9.0	4/26/97	0.75	12.3
4/26/97	1.45	0.6	4/26/97	1.45	7.6
4/27/97	0	8.8	4/27/97	0	10.2
4/27/97	0.75	8.7	4/27/97	0.75	10.1
4/27/97	1.45	0.2	4/27/97	1.45	0.2
4/28/97	0	5.3	4/28/97	0	10.3
4/28/97	0.75	4.9	4/28/97	0.75	10.2
4/28/97	1.45	0.1	4/28/97	1.45	3.6

Dissolved oxygen profile for pond 21.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/29/97	0	6.5	4/29/97	0	11.1
4/29/97	0.75	6.5	4/29/97	0.75	10.8
4/29/97	1.45	3.2	4/29/97	1.45	4.0
4/30/97	0	10.0	4/30/97	0	11.9
4/30/97	0.75	5.0	4/30/97	0.75	11.8
4/30/97	1.45	0.7	4/30/97	1.45	8.0
5/1/97	0	7.2	5/1/97	0	10.9
5/1/97	0.75	6.9	5/1/97	0.75	10.5
5/1/97	1.45	0.3	5/1/97	1.45	5.0
5/2/97	0	6.5	5/2/97	0	12.1
5/2/97	0.75	6.4	5/2/97	0.75	12.1
5/2/97	1.45	1.2	5/2/97	1.45	3.1
5/3/97	0	6.3	5/3/97	0	9.4
5/3/97	0.75	6.3	5/3/97	0.75	9.3
5/3/97	1.45	0.5	5/3/97	1.45	4.3
5/4/97	0	5.4	5/4/97	0	12.6
5/4/97	0.75	5.4	5/4/97	0.75	12.5
5/4/97	1.45	5.1	5/4/97	1.45	5.2
5/5/97	0	7.8	5/5/97	0	12.3
5/5/97	0.75	7.9	5/5/97	0.75	12.3
5/5/97	1.45	7.2	5/5/97	1.45	5.2
5/6/97	0	7.5	5/6/97	0	15.8
5/6/97	0.75	7.6	5/6/97	0.75	13.5
5/6/97	1.45	6.6	5/6/97	1.45	4.1
5/7/97	0	10.5	5/7/97	0	16.1
5/7/97	0.75	10.3	5/7/97	0.75	17.9
5/7/97	1.45	0.2	5/7/97	1.45	0.2
5/8/97	0	11.5	5/8/97	0	11.7
5/8/97	0.75	11.5	5/8/97	0.75	10.7
5/8/97	1.45	0.1	5/8/97	1.45	0.4
5/9/97	0	6.8	5/9/97	0	12.5
5/9/97	0.75	6.5	5/9/97	0.75	12.4
5/9/97	1.45	0.3	5/9/97	1.45	3.1
5/10/97	0	5.9	5/10/97	0	13.6
5/10/97	0.75	5.9	5/10/97	0.75	13.5
5/10/97	1.45	5.3	5/10/97	1.45	5.7
5/11/97	0	10.2	5/11/97	0	10.6
5/11/97	0.75	9.6	5/11/97	0.75	10.6
5/11/97	1.45	0.5	5/11/97	1.45	9.9
5/12/97	0	10.7	5/12/97	0	8.6
5/12/97	0.75	9.7	5/12/97	0.75	8.5
5/12/97	1.45	0.2	5/12/97	1.45	0.1

Dissolved oxygen profile for pond 21.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
5/13/97	0	5.4	5/13/97	0	9.0
5/13/97	0.75	5.4	5/13/97	0.75	8.9
5/13/97	1.45	0.5	5/13/97	1.45	0.3
5/14/97	0	8.1	5/14/97	0	9.7
5/14/97	0.75	8.0	5/14/97	0.75	9.1
5/14/97	1.45	1.0	5/14/97	1.45	0.6
5/15/97	0	5.9	5/15/97	0	8.8
5/15/97	0.75	5.2	5/15/97	0.75	8.4
5/15/97	1.45	0.1	5/15/97	1.45	0.3
5/16/97	0	4.9	5/16/97	0	8.3
5/16/97	0.75	4.9	5/16/97	0.75	6.7
5/16/97	1.45	2.5	5/16/97	1.45	2.6
5/17/97	0	5.7	5/17/97	0	8.2
5/17/97	0.75	5.7	5/17/97	0.75	5.8
5/17/97	1.45	0.1	5/17/97	1.45	0.1
5/18/97	0	3.9	5/18/97	0	8.9
5/18/97	0.75	0.7	5/18/97	0.75	8.4
5/18/97	1.45	0.3	5/18/97	1.45	0.1
5/19/97	0	4.7	5/19/97	0	9.1
5/19/97	0.75	1.8	5/19/97	0.75	8.8
5/19/97	1.45	0.5	5/19/97	1.45	2.4
5/20/97	0	4.7	5/20/97	0	11.0
5/20/97	0.75	4.6	5/20/97	0.75	9.3
5/20/97	1.45	0.1	5/20/97	1.45	0.2
5/21/97	0	6.9	5/21/97	0	10.7
5/21/97	0.75	6.8	5/21/97	0.75	10.6
5/21/97	1.45	0.1	5/21/97	1.45	0.1
5/22/97	0	6.9	5/22/97	0	10.6
5/22/97	0.75	6.9	5/22/97	0.75	12.0
5/22/97	1.45	0.5	5/22/97	1.45	9.4

Dissolved oxygen profile for pond 30.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/15/97	0	10.6	4/15/97	0	11.8
4/15/97	0.75	11.3	4/15/97	0.75	12.8
4/15/97	1.45	11.5	4/15/97	1.45	13.4
4/16/97	0	10.4	4/16/97	0	12.0
4/16/97	0.75	10.6	4/16/97	0.75	12.1
4/16/97	1.45	11.0	4/16/97	1.45	13.0
4/17/97	0	10.0	4/17/97	0	11.8
4/17/97	0.75	10.4	4/17/97	0.75	12.0
4/17/97	1.45	10.2	4/17/97	1.45	12.3
4/18/97	0	12.0	4/18/97	0	11.6
4/18/97	0.75	12.3	4/18/97	0.75	12.0
4/18/97	1.45	12.4	4/18/97	1.45	12.2
4/19/97	0	11.0	4/19/97	0	11.3
4/19/97	0.75	11.1	4/19/97	0.75	11.3
4/19/97	1.45	11.1	4/19/97	1.45	11.8
4/20/97	0	10.7	4/20/97	0	11.5
4/20/97	0.75	10.5	4/20/97	0.75	11.5
4/20/97	1.45	10.3	4/20/97	1.45	11.6
4/21/97	0	10.6	4/21/97	0	10.8
4/21/97	0.75	10.6	4/21/97	0.75	11.2
4/21/97	1.45	11.1	4/21/97	1.45	11.7
4/22/97	0	9.4	4/22/97	0	10.2
4/22/97	0.75	9.3	4/22/97	0.75	11.2
4/22/97	1.45	8.7	4/22/97	1.45	11.6
4/23/97	0	8.7	4/23/97	0	9.4
4/23/97	0.75	8.6	4/23/97	0.75	9.4
4/23/97	1.45	8.9	4/23/97	1.45	9.2
4/24/97	0	7.6	4/24/97	0	10.8
4/24/97	0.75	7.3	4/24/97	0.75	10.8
4/24/97	1.45	7.4	4/24/97	1.45	10.3
4/25/97	0	7.6	4/25/97	0	11.3
4/25/97	0.75	7.6	4/25/97	0.75	11.5
4/25/97	1.45	7.1	4/25/97	1.45	11.8
4/26/97	0	8.8	4/26/97	0	11.6
4/26/97	0.75	8.7	4/26/97	0.75	11.7
4/26/97	1.45	5.9	4/26/97	1.45	11.8
4/27/97	0	8.1	4/27/97	0	7.5
4/27/97	0.75	8.0	4/27/97	0.75	7.5
4/27/97	1.45	0.9	4/27/97	1.45	1.9
4/28/97	0	5.8	4/28/97	0	8.0
4/28/97	0.75	5.8	4/28/97	0.75	7.8
4/28/97	1.45	5.7	4/28/97	1.45	6.8

Dissolved oxygen profile for pond 30.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/29/97	0	5.2	4/29/97	0	8.1
4/29/97	0.75	5.1	4/29/97	0.75	7.9
4/29/97	1.45	5.0	4/29/97	1.45	5.9
4/30/97	0	6.6	4/30/97	0	12.9
4/30/97	0.75	6.5	4/30/97	0.75	12.6
4/30/97	1.45	1.8	4/30/97	1.45	0.9
5/1/97	0	7.8	5/1/97	0	11.3
5/1/97	0.75	7.7	5/1/97	0.75	11.2
5/1/97	1.45	7.6	5/1/97	1.45	10.5
5/2/97	0	7.1	5/2/97	0	11.9
5/2/97	0.75	7.0	5/2/97	0.75	11.8
5/2/97	1.45	6.9	5/2/97	1.45	11.7
5/3/97	0	6.5	5/3/97	0	8.9
5/3/97	0.75	6.5	5/3/97	0.75	8.9
5/3/97	1.45	6.4	5/3/97	1.45	8.8
5/4/97	0	5.6	5/4/97	0	11.6
5/4/97	0.75	5.6	5/4/97	0.75	11.6
5/4/97	1.45	5.5	5/4/97	1.45	11.5
5/5/97	0	6.6	5/5/97	0	9.3
5/5/97	0.75	6.6	5/5/97	0.75	9.3
5/5/97	1.45	6.6	5/5/97	1.45	9.2
5/6/97	0	7.0	5/6/97	0	10.7
5/6/97	0.75	6.5	5/6/97	0.75	10.2
5/6/97	1.45	6.6	5/6/97	1.45	9.1
5/7/97	0	6.5	5/7/97	0	9.9
5/7/97	0.75	6.2	5/7/97	0.75	11.1
5/7/97	1.45	1.6	5/7/97	1.45	8.0
5/8/97	0	5.9	5/8/97	0	6.3
5/8/97	0.75	5.8	5/8/97	0.75	4.8
5/8/97	1.45	0.1	5/8/97	1.45	3.4
5/9/97	0	4.8	5/9/97	0	7.5
5/9/97	0.75	4.8	5/9/97	0.75	7.4
5/9/97	1.45	4.6	5/9/97	1.45	5.4
5/10/97	0	5.1	5/10/97	0	9.3
5/10/97	0.75	5.1	5/10/97	0.75	9.3
5/10/97	1.45	4.9	5/10/97	1.45	8.9
5/11/97	0	6.2	5/11/97	0	14.4
5/11/97	0.75	6.0	5/11/97	0.75	14.3
5/11/97	1.45	5.9	5/11/97	1.45	0.8
5/12/97	0	9.7	5/12/97	0	8.2
5/12/97	0.75	9.6	5/12/97	0.75	8.1
5/12/97	1.45	9.4	5/12/97	1.45	8.0

Dissolved oxygen profile for pond 30.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
5/13/97	0	5.4	5/13/97	0	7.5
5/13/97	0.75	5.4	5/13/97	0.75	7.4
5/13/97	1.45	5.4	5/13/97	1.45	7.3
5/14/97	0	8.0	5/14/97	0	9.3
5/14/97	0.75	6.1	5/14/97	0.75	9.2
5/14/97	1.45	6.2	5/14/97	1.45	7.9
5/15/97	0	6.6	5/15/97	0	9.2
5/15/97	0.75	6.6	5/15/97	0.75	8.9
5/15/97	1.45	6.6	5/15/97	1.45	7.1
5/16/97	0	6.2	5/16/97	0	8.0
5/16/97	0.75	6.1	5/16/97	0.75	8.6
5/16/97	1.45	6.1	5/16/97	1.45	8.1
5/17/97	0	6.9	5/17/97	0	8.9
5/17/97	0.75	6.8	5/17/97	0.75	8.9
5/17/97	1.45	6.1	5/17/97	1.45	6.9
5/18/97	0	7.0	5/18/97	0	10.1
5/18/97	0.75	7.0	5/18/97	0.75	10.3
5/18/97	1.45	2.8	5/18/97	1.45	7.4
5/19/97	0	7.8	5/19/97	0	8.9
5/19/97	0.75	7.3	5/19/97	0.75	9.6
5/19/97	1.45	4.0	5/19/97	1.45	8.6
5/20/97	0	6.1	5/20/97	0	10.0
5/20/97	0.75	6.0	5/20/97	0.75	9.9
5/20/97	1.45	1.0	5/20/97	1.45	1.3
5/21/97	0	6.8	5/21/97	0	10.4
5/21/97	0.75	6.7	5/21/97	0.75	10.3
5/21/97	1.45	2.4	5/21/97	1.45	5.8
5/22/97	0	7.4	5/22/97	0	10.2
5/22/97	0.75	7.4	5/22/97	0.75	9.9
5/22/97	1.45	6.9	5/22/97	1.45	0.1

Dissolved oxygen profile for pond 64.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/15/97	0	10.4	4/15/97	0	12.0
4/15/97	0.75	10.6	4/15/97	0.75	12.8
4/15/97	1.45	12.8	4/15/97	1.45	11.6
4/16/97	0	9.8	4/16/97	0	11.2
4/16/97	0.75	9.9	4/16/97	0.75	11.4
4/16/97	1.45	10.0	4/16/97	1.45	11.3
4/17/97	0	9.2	4/17/97	0	10.6
4/17/97	0.75	9.4	4/17/97	0.75	10.7
4/17/97	1.45	9.7	4/17/97	1.45	10.9
4/18/97	0	9.6	4/18/97	0	10.6
4/18/97	0.75	9.7	4/18/97	0.75	10.8
4/18/97	1.45	10.0	4/18/97	1.45	11.1
4/19/97	0	9.6	4/19/97	0	10.4
4/19/97	0.75	9.6	4/19/97	0.75	10.2
4/19/97	1.45	9.6	4/19/97	1.45	10.5
4/20/97	0	8.8	4/20/97	0	10.4
4/20/97	0.75	8.7	4/20/97	0.75	10.6
4/20/97	1.45	8.6	4/20/97	1.45	10.5
4/21/97	0	9.3	4/21/97	0	10.3
4/21/97	0.75	9.3	4/21/97	0.75	10.8
4/21/97	1.45	9.4	4/21/97	1.45	10.6
4/22/97	0	8.4	4/22/97	0	9.8
4/22/97	0.75	8.3	4/22/97	0.75	11.1
4/22/97	1.45	7.1	4/22/97	1.45	10.8
4/23/97	0	8.9	4/23/97	0	9.1
4/23/97	0.75	8.3	4/23/97	0.75	9.1
4/23/97	1.45	8.1	4/23/97	1.45	3.2
4/24/97	0	6.8	4/24/97	0	9.9
4/24/97	0.75	6.8	4/24/97	0.75	9.9
4/24/97	1.45	6.5	4/24/97	1.45	9.5
4/25/97	0	7.0	4/25/97	0	9.6
4/25/97	0.75	7.0	4/25/97	0.75	9.6
4/25/97	1.45	6.1	4/25/97	1.45	10.6
4/26/97	0	7.5	4/26/97	0	9.7
4/26/97	0.75	7.4	4/26/97	0.75	9.7
4/26/97	1.45	5.9	4/26/97	1.45	9.0
4/27/97	0	7.4	4/27/97	0	7.3
4/27/97	0.75	7.0	4/27/97	0.75	7.2
4/27/97	1.45	4.7	4/27/97	1.45	1.1
4/28/97	0	5.5	4/28/97	0	6.1
4/28/97	0.75	5.4	4/28/97	0.75	6.0
4/28/97	1.45	5.4	4/28/97	1.45	5.3

Dissolved oxygen profile for pond 64.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/29/97	0	4.5	4/29/97	0	6.5
4/29/97	0.75	4.5	4/29/97	0.75	6.1
4/29/97	1.45	4.5	4/29/97	1.45	5.5
4/30/97	0	4.9	4/30/97	0	8.0
4/30/97	0.75	5.0	4/30/97	0.75	7.2
4/30/97	1.45	2.3	4/30/97	1.45	6.8
5/1/97	0	6.5	5/1/97	0	8.0
5/1/97	0.75	6.5	5/1/97	0.75	8.0
5/1/97	1.45	6.5	5/1/97	1.45	7.4
5/2/97	0	6.2	5/2/97	0	11.2
5/2/97	0.75	6.2	5/2/97	0.75	11.0
5/2/97	1.45	6.1	5/2/97	1.45	6.2
5/3/97	0	7.1	5/3/97	0	9.5
5/3/97	0.75	7.1	5/3/97	0.75	9.5
5/3/97	1.45	7.0	5/3/97	1.45	9.4
5/4/97	0	6.7	5/4/97	0	13.6
5/4/97	0.75	6.6	5/4/97	0.75	13.6
5/4/97	1.45	6.5	5/4/97	1.45	13.5
5/5/97	0	9.9	5/5/97	0	14.7
5/5/97	0.75	9.9	5/5/97	0.75	14.7
5/5/97	1.45	9.9	5/5/97	1.45	14.6
5/6/97	0	10.0	5/6/97	0	17.3
5/6/97	0.75	10.0	5/6/97	0.75	14.3
5/6/97	1.45	10.0	5/6/97	1.45	10.2
5/7/97	0	11.4	5/7/97	0	18.0
5/7/97	0.75	11.1	5/7/97	0.75	15.2
5/7/97	1.45	0.6	5/7/97	1.45	3.0
5/8/97	0	11.2	5/8/97	0	10.8
5/8/97	0.75	10.5	5/8/97	0.75	8.9
5/8/97	1.45	0.2	5/8/97	1.45	0.2
5/9/97	0	6.7	5/9/97	0	9.9
5/9/97	0.75	6.7	5/9/97	0.75	9.5
5/9/97	1.45	6.7	5/9/97	1.45	0.5
5/10/97	0	4.4	5/10/97	0	8.7
5/10/97	0.75	4.4	5/10/97	0.75	8.6
5/10/97	1.45	4.4	5/10/97	1.45	8.6
5/11/97	0	5.6	5/11/97	0	10.1
5/11/97	0.75	5.5	5/11/97	0.75	10.1
5/11/97	1.45	5.4	5/11/97	1.45	8.5
5/12/97	0	8.2	5/12/97	0	7.7
5/12/97	0.75	8.1	5/12/97	0.75	7.6
5/12/97	1.45	8.0	5/12/97	1.45	7.6

Dissolved oxygen profile for pond 64.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
5/13/97	0	5.3	5/13/97	0	8.7
5/13/97	0.75	5.3	5/13/97	0.75	8.5
5/13/97	1.45	5.2	5/13/97	1.45	7.5
5/14/97	0	6.7	5/14/97	0	10.3
5/14/97	0.75	6.6	5/14/97	0.75	10.1
5/14/97	1.45	6.5	5/14/97	1.45	5.7
5/15/97	0	7.4	5/15/97	0	9.9
5/15/97	0.75	7.4	5/15/97	0.75	9.4
5/15/97	1.45	7.4	5/15/97	1.45	9.0
5/16/97	0	6.9	5/16/97	0	8.6
5/16/97	0.75	6.5	5/16/97	0.75	8.6
5/16/97	1.45	6.4	5/16/97	1.45	8.2
5/17/97	0	7.1	5/17/97	0	8.3
5/17/97	0.75	7.0	5/17/97	0.75	8.0
5/17/97	1.45	5.9	5/17/97	1.45	5.8
5/18/97	0	6.9	5/18/97	0	8.1
5/18/97	0.75	6.8	5/18/97	0.75	7.3
5/18/97	1.45	0.8	5/18/97	1.45	0.9
5/19/97	0	6.0	5/19/97	0	6.0
5/19/97	0.75	5.9	5/19/97	0.75	6.0
5/19/97	1.45	0.8	5/19/97	1.45	0.2
5/20/97	0	3.3	5/20/97	0	7.5
5/20/97	0.75	3.3	5/20/97	0.75	7.3
5/20/97	1.45	0.1	5/20/97	1.45	2.8
5/21/97	0	4.5	5/21/97	0	8.9
5/21/97	0.75	4.4	5/21/97	0.75	8.6
5/21/97	1.45	3.3	5/21/97	1.45	5.0
5/22/97	0	5.8	5/22/97	0	10.2
5/22/97	0.75	5.8	5/22/97	0.75	10.6
5/22/97	1.45	5.6	5/22/97	1.45	10.4

Dissolved oxygen profile for pond 72.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/15/97	0	10.6	4/15/97	0	12.1
4/15/97	0.75	11.8	4/15/97	0.75	12.7
4/15/97	1.45	12.1	4/15/97	1.45	12.7
4/16/97	0	10.8	4/16/97	0	11.8
4/16/97	0.75	10.9	4/16/97	0.75	12.2
4/16/97	1.45	10.5	4/16/97	1.45	11.3
4/17/97	0	11.0	4/17/97	0	11.6
4/17/97	0.75	11.3	4/17/97	0.75	11.7
4/17/97	1.45	10.3	4/17/97	1.45	11.6
4/18/97	0	10.9	4/18/97	0	11.2
4/18/97	0.75	11.2	4/18/97	0.75	11.5
4/18/97	1.45	11.5	4/18/97	1.45	11.6
4/19/97	0	11.8	4/19/97	0	13.7
4/19/97	0.75	11.9	4/19/97	0.75	13.6
4/19/97	1.45	12.5	4/19/97	1.45	13.3
4/20/97	0	11.9	4/20/97	0	12.5
4/20/97	0.75	11.9	4/20/97	0.75	13.3
4/20/97	1.45	11.6	4/20/97	1.45	13.5
4/21/97	0	12.4	4/21/97	0	12.6
4/21/97	0.75	12.4	4/21/97	0.75	13.0
4/21/97	1.45	12.9	4/21/97	1.45	13.6
4/22/97	0	12.4	4/22/97	0	12.9
4/22/97	0.75	12.4	4/22/97	0.75	13.0
4/22/97	1.45	12.2	4/22/97	1.45	14.3
4/23/97	0	11.7	4/23/97	0	11.8
4/23/97	0.75	11.7	4/23/97	0.75	11.8
4/23/97	1.45	11.6	4/23/97	1.45	11.7
4/24/97	0	11.5	4/24/97	0	11.3
4/24/97	0.75	11.5	4/24/97	0.75	11.7
4/24/97	1.45	11.5	4/24/97	1.45	12.3
4/25/97	0	10.5	4/25/97	0	11.5
4/25/97	0.75	10.5	4/25/97	0.75	11.5
4/25/97	1.45	10.4	4/25/97	1.45	11.8
4/26/97	0	11.0	4/26/97	0	11.5
4/26/97	0.75	10.9	4/26/97	0.75	11.5
4/26/97	1.45	10.9	4/26/97	1.45	12.0
4/27/97	0	10.7	4/27/97	0	10.5
4/27/97	0.75	10.7	4/27/97	0.75	10.5
4/27/97	1.45	11.2	4/27/97	1.45	10.5
4/28/97	0	10.2	4/28/97	0	11.0
4/28/97	0.75	10.2	4/28/97	0.75	11.0
4/28/97	1.45	10.1	4/28/97	1.45	10.9

Dissolved oxygen profile for pond 72.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/29/97	0	10.1	4/29/97	0	11.2
4/29/97	0.75	10.1	4/29/97	0.75	11.2
4/29/97	1.45	10.0	4/29/97	1.45	11.6
4/30/97	0	10.8	4/30/97	0	11.7
4/30/97	0.75	10.8	4/30/97	0.75	11.7
4/30/97	1.45	11.0	4/30/97	1.45	13.3
5/1/97	0	9.9	5/1/97	0	11.3
5/1/97	0.75	9.9	5/1/97	0.75	11.4
5/1/97	1.45	11.6	5/1/97	1.45	9.6
5/2/97	0	9.7	5/2/97	0	13.0
5/2/97	0.75	9.7	5/2/97	0.75	12.9
5/2/97	1.45	9.6	5/2/97	1.45	12.9
5/3/97	0	10.1	5/3/97	0	11.6
5/3/97	0.75	10.0	5/3/97	0.75	11.6
5/3/97	1.45	10.0	5/3/97	1.45	11.5
5/4/97	0	9.5	5/4/97	0	14.3
5/4/97	0.75	9.3	5/4/97	0.75	14.3
5/4/97	1.45	9.2	5/4/97	1.45	14.4
5/5/97	0	11.5	5/5/97	0	13.6
5/5/97	0.75	11.5	5/5/97	0.75	13.6
5/5/97	1.45	11.4	5/5/97	1.45	13.5
5/6/97	0	10.4	5/6/97	0	13.1
5/6/97	0.75	10.4	5/6/97	0.75	13.1
5/6/97	1.45	10.3	5/6/97	1.45	13.3
5/7/97	0	11.1	5/7/97	0	12.2
5/7/97	0.75	11.1	5/7/97	0.75	12.5
5/7/97	1.45	10.9	5/7/97	1.45	13.1
5/8/97	0	10.3	5/8/97	0	11.5
5/8/97	0.75	10.2	5/8/97	0.75	11.4
5/8/97	1.45	9.9	5/8/97	1.45	9.1
5/9/97	0	9.9	5/9/97	0	11.6
5/9/97	0.75	9.9	5/9/97	0.75	11.5
5/9/97	1.45	9.9	5/9/97	1.45	11.3
5/10/97	0	9.4	5/10/97	0	11.7
5/10/97	0.75	9.4	5/10/97	0.75	11.7
5/10/97	1.45	9.4	5/10/97	1.45	11.7
5/11/97	0	9.8	5/11/97	0	11.4
5/11/97	0.75	9.8	5/11/97	0.75	11.4
5/11/97	1.45	9.8	5/11/97	1.45	12.6
5/12/97	0	10.5	5/12/97	0	11.4
5/12/97	0.75	10.4	5/12/97	0.75	11.3
5/12/97	1.45	10.4	5/12/97	1.45	11.3

Dissolved oxygen profile for pond 72.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
5/13/97	0	10.0	5/13/97	0	10.7
5/13/97	0.75	10.0	5/13/97	0.75	10.8
5/13/97	1.45	10.0	5/13/97	1.45	10.8
5/14/97	0	10.6	5/14/97	0	12.9
5/14/97	0.75	10.5	5/14/97	0.75	13.1
5/14/97	1.45	10.4	5/14/97	1.45	12.6
5/15/97	0	10.4	5/15/97	0	12.0
5/15/97	0.75	10.4	5/15/97	0.75	11.9
5/15/97	1.45	10.4	5/15/97	1.45	10.3
5/16/97	0	9.6	5/16/97	0	12.1
5/16/97	0.75	9.6	5/16/97	0.75	12.1
5/16/97	1.45	9.3	5/16/97	1.45	11.5
5/17/97	0	10.5	5/17/97	0	12.0
5/17/97	0.75	10.5	5/17/97	0.75	12.1
5/17/97	1.45	10.4	5/17/97	1.45	12.2
5/18/97	0	10.6	5/18/97	0	13.5
5/18/97	0.75	10.6	5/18/97	0.75	13.4
5/18/97	1.45	5.9	5/18/97	1.45	13.1
5/19/97	0	9.9	5/19/97	0	11.9
5/19/97	0.75	11.0	5/19/97	0.75	11.8
5/19/97	1.45	4.2	5/19/97	1.45	9.9
5/20/97	0	9.2	5/20/97	0	10.6
5/20/97	0.75	9.1	5/20/97	0.75	10.5
5/20/97	1.45	2.2	5/20/97	1.45	9.8
5/21/97	0	7.5	5/21/97	0	7.7
5/21/97	0.75	7.4	5/21/97	0.75	7.5
5/21/97	1.45	7.3	5/21/97	1.45	7.1
5/22/97	0	5.5	5/22/97	0	6.9
5/22/97	0.75	5.5	5/22/97	0.75	6.8
5/22/97	1.45	5.4	5/22/97	1.45	6.7

Dissolved oxygen profile for pond 78.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/15/97	0	10.2	4/15/97	0	11.6
4/15/97	0.75	10.4	4/15/97	0.75	12.6
4/15/97	1.45	10.2	4/15/97	1.45	12.0
4/16/97	0	10.4	4/16/97	0	11.2
4/16/97	0.75	10.8	4/16/97	0.75	11.4
4/16/97	1.45	10.4	4/16/97	1.45	12.3
4/17/97	0	10.8	4/17/97	0	11.3
4/17/97	0.75	11.0	4/17/97	0.75	11.5
4/17/97	1.45	10.8	4/17/97	1.45	12.1
4/18/97	0	12.2	4/18/97	0	11.4
4/18/97	0.75	12.5	4/18/97	0.75	11.8
4/18/97	1.45	12.2	4/18/97	1.45	12.0
4/19/97	0	11.6	4/19/97	0	12.8
4/19/97	0.75	11.6	4/19/97	0.75	12.9
4/19/97	1.45	11.6	4/19/97	1.45	13.1
4/20/97	0	11.9	4/20/97	0	12.9
4/20/97	0.75	11.8	4/20/97	0.75	13.0
4/20/97	1.45	11.9	4/20/97	1.45	13.3
4/21/97	0	12.5	4/21/97	0	13.0
4/21/97	0.75	12.5	4/21/97	0.75	13.4
4/21/97	1.45	12.5	4/21/97	1.45	13.6
4/22/97	0	12.7	4/22/97	0	11.8
4/22/97	0.75	12.6	4/22/97	0.75	13.4
4/22/97	1.45	12.7	4/22/97	1.45	13.9
4/23/97	0	12.0	4/23/97	0	11.2
4/23/97	0.75	11.9	4/23/97	0.75	11.2
4/23/97	1.45	12.0	4/23/97	1.45	11.2
4/24/97	0	11.3	4/24/97	0	11.5
4/24/97	0.75	11.2	4/24/97	0.75	11.7
4/24/97	1.45	11.3	4/24/97	1.45	12.8
4/25/97	0	10.6	4/25/97	0	11.3
4/25/97	0.75	10.6	4/25/97	0.75	12.3
4/25/97	1.45	10.6	4/25/97	1.45	12.8
4/26/97	0	11.5	4/26/97	0	11.6
4/26/97	0.75	11.4	4/26/97	0.75	11.6
4/26/97	1.45	11.5	4/26/97	1.45	10.0
4/27/97	0	10.8	4/27/97	0	10.7
4/27/97	0.75	10.7	4/27/97	0.75	10.7
4/27/97	1.45	10.8	4/27/97	1.45	9.8
4/28/97	0	10.5	4/28/97	0	11.6
4/28/97	0.75	10.4	4/28/97	0.75	11.6
4/28/97	1.45	10.5	4/28/97	1.45	11.6

Dissolved oxygen profile for pond 78.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
4/29/97	0	10.4	4/29/97	0	11.8
4/29/97	0.75	10.4	4/29/97	0.75	11.8
4/29/97	1.45	10.4	4/29/97	1.45	12.1
4/30/97	0	11.7	4/30/97	0	12.4
4/30/97	0.75	11.8	4/30/97	0.75	12.6
4/30/97	1.45	11.7	4/30/97	1.45	15.5
5/1/97	0	10.8	5/1/97	0	12.0
5/1/97	0.75	10.9	5/1/97	0.75	12.0
5/1/97	1.45	10.8	5/1/97	1.45	10.4
5/2/97	0	10.7	5/2/97	0	13.3
5/2/97	0.75	10.7	5/2/97	0.75	13.2
5/2/97	1.45	10.7	5/2/97	1.45	13.1
5/3/97	0	10.3	5/3/97	0	11.7
5/3/97	0.75	10.3	5/3/97	0.75	11.7
5/3/97	1.45	10.3	5/3/97	1.45	11.6
5/4/97	0	9.7	5/4/97	0	13.3
5/4/97	0.75	9.7	5/4/97	0.75	13.3
5/4/97	1.45	9.7	5/4/97	1.45	13.2
5/5/97	0	10.9	5/5/97	0	12.3
5/5/97	0.75	10.9	5/5/97	0.75	12.3
5/5/97	1.45	10.9	5/5/97	1.45	12.2
5/6/97	0	10.2	5/6/97	0	12.7
5/6/97	0.75	10.2	5/6/97	0.75	12.7
5/6/97	1.45	10.2	5/6/97	1.45	13.8
5/7/97	0	10.5	5/7/97	0	11.5
5/7/97	0.75	10.4	5/7/97	0.75	12.3
5/7/97	1.45	10.5	5/7/97	1.45	13.0
5/8/97	0	9.6	5/8/97	0	10.7
5/8/97	0.75	9.5	5/8/97	0.75	10.6
5/8/97	1.45	9.6	5/8/97	1.45	8.7
5/9/97	0	9.9	5/9/97	0	11.6
5/9/97	0.75	9.9	5/9/97	0.75	11.5
5/9/97	1.45	9.9	5/9/97	1.45	11.0
5/10/97	0	9.5	5/10/97	0	12.3
5/10/97	0.75	9.6	5/10/97	0.75	12.3
5/10/97	1.45	9.5	5/10/97	1.45	12.3
5/11/97	0	10.2	5/11/97	0	13.4
5/11/97	0.75	10.2	5/11/97	0.75	14.4
5/11/97	1.45	10.2	5/11/97	1.45	15.9
5/12/97	0	13.2	5/12/97	0	13.6
5/12/97	0.75	13.2	5/12/97	0.75	13.5
5/12/97	1.45	13.2	5/12/97	1.45	13.4

Dissolved oxygen profile for pond 78.

Date	Depth Meters	D.O.(AM) ppm	Date	Depth Meters	D.O.(PM) ppm
5/13/97	0	11.8	5/13/97	0	13.1
5/13/97	0.75	11.8	5/13/97	0.75	14.5
5/13/97	1.45	11.8	5/13/97	1.45	14.8
5/14/97	0	13.4	5/14/97	0	15.5
5/14/97	0.75	13.3	5/14/97	0.75	16.3
5/14/97	1.45	13.4	5/14/97	1.45	16.6
5/15/97	0	12.9	5/15/97	0	12.3
5/15/97	0.75	12.6	5/15/97	0.75	12.2
5/15/97	1.45	12.9	5/15/97	1.45	12.0
5/16/97	0	11.7	5/16/97	0	12.2
5/16/97	0.75	11.5	5/16/97	0.75	12.9
5/16/97	1.45	11.7	5/16/97	1.45	13.8
5/17/97	0	11.8	5/17/97	0	13.0
5/17/97	0.75	12.0	5/17/97	0.75	13.6
5/17/97	1.45	11.8	5/17/97	1.45	12.7
5/18/97	0	11.7	5/18/97	0	13.5
5/18/97	0.75	11.7	5/18/97	0.75	14.8
5/18/97	1.45	11.7	5/18/97	1.45	14.1
5/19/97	0	10.8	5/19/97	0	12.2
5/19/97	0.75	10.8	5/19/97	0.75	14.4
5/19/97	1.45	10.8	5/19/97	1.45	12.6
5/20/97	0	9.9	5/20/97	0	13.1
5/20/97	0.75	9.8	5/20/97	0.75	14.0
5/20/97	1.45	9.9	5/20/97	1.45	13.1
5/21/97	0	10.8	5/21/97	0	12.3
5/21/97	0.75	10.8	5/21/97	0.75	12.3
5/21/97	1.45	10.8	5/21/97	1.45	12.7
5/22/97	0	10.0	5/22/97	0	10.9
5/22/97	0.75	10.0	5/22/97	0.75	12.0
5/22/97	1.45	10.0	5/22/97	1.45	11.0

Appendix 4. Hatchery rearing pond phytoplankton species list for inorganic and organic ponds for the 1997 growing season.

Appendix 4: Phytoplankton list.

Species	Inorganic	Organic	Species	Inorganic	Organic
Actinastrum	O	X	Lyngbya	X	O
Agmenellum	X	X	Marssoniella	O	X
Anabaena	X	X	Micractinium	X	X
Anacystis	O	X	Microsporia	X	O
Ankistrodesmus	X	X	Navicula	X	X
Arthrodesmus	X	X	Nitzchia	X	X
Asterionella	X	X	Nostoc	O	X
Bohlinia	X	O	Oedogonium	X	O
Binuclaeria	X	O	Oscillatoria	X	X
Calothrix	O	X	Ourococcus	X	X
Centritractus	X	O	Pandorina	X	O
Chlamydomonas	X	X	Pediastrum	X	X
Chlorella	X	X	Pinnularia	O	X
Chroomonas	O	X	Pleodorina	O	X
Closterium	O	X	Pseudotetraedron	O	X
Coelastrum	O	X	Rhodomonas	O	X
Coscinodiscus	X	X	Rivularia	O	X
Cosmarium	X	X	Scenedesmus	X	X
Cosmocladium	O	X	Schizogonium	O	X
Cyclotella	X	X	Schroederia	X	X
Cymbella	X	X	Sphaerocystics	X	X
Diatoma	X	X	Sphaerozosma	X	X
Dictyosphaerium	X	X	Spirogyra	X	X
Dimorphococcus	X	X	Spirtaenia	O	X
Dinobryon	X	X	Stauroneis	O	X
Elakatothrix	O	X	Stephanodiscus	O	X
Euastrum	O	X	Surirella	X	X
Eudorina	X	X	Synedra	X	X
Euglena	X	O	Tabillaria	X	X
Fragilaria	X	X	Tetrahedron	X	X
Frustulia	X	X	Tribonema	X	X
Gleobotrys	X	O	Ulothrix	X	X
Gleotheca	O	X	Uroglenopsis	X	X
Gonium	X	X	Volvox	X	X
Hydrodictyon	O	X	Zygnema	X	X
Kirchnerrella	O	X			

X=Present O=Absent

Appendix 5. Hatchery rearing pond zooplankton species list for the inorganic and organic ponds for the 1997 growing season.

Appendix 5: Zooplankton list.

Species	Inorganic	Organic
Asplanchna	X	X
Asplanchnopus	X	O
Bosmina	X	X
Brachionus	X	X
Brachionus furculatus	X	X
Calanoid copepod	X	X
Cephalodella	X	X
Cyclopoid copepod	X	X
Daphnia	X	X
Daphnia pulex	X	X
Daphnia rosea	X	X
Diaptomus	O	X
Epiphanes	X	X
Eubosmina	O	X
Filinia	X	X
Kellicotie	X	X
Keratella	X	X
Lecane	X	X
Leptodora	X	X
Macrothrix	O	X
Napulii	X	X
Ostracod	X	X
Philodina	O	X
Polyarthra	X	X
Proales	O	X
Synchaeta	X	X
Testudinella	X	O
Tetramastix	O	X
Trichocerca	X	X
Trochosphaera	X	X

X=Present O=Absent

Appendix 6. List of Phytoplankton genera counted within the rearing ponds during the 1997 growing season.

Appendix 6: Phytoplankton genera counted within the inorganic rearing ponds.

I. Green Algae

Kingdom Plante
- Division Chlorophyta
  - Order Volvocales
    - Family Chlamydomonaceae
      - Genus *Chlamydomonas sp.*
    - Family Volvocaceae
      - Genus *Eudorina sp.*
      - Genus *Gonuim sp.*
      - Genus *Pandorina sp.*
      - Genus *Volvox sp.*
  - Order Tetrasporales
    - Family Hypnomonadaceae
      - Genus *Sphaerocystis sp.*
  - Order Chlorococcales
    - Family Chlorococcaceae
      - Genus *Schroederia sp.*
      - Genus *Tetraheddron sp.*
    - Family Dictyosphaeriaceae
      - Genus *Dictyosphaerium sp.*
      - Genus *Dimorphococcus sp.*
    - Family Oocystaceae
      - Genus *Ankistrodesmus sp.*
      - Genus *Bohlina sp.*
      - Genus *Chlorella sp.*
      - Genus *Oocystis sp.*
    - Family Micractiniaceae
      - Genus *Micractinium sp.*
    - Family Scenedesmaceae
      - Genus *Scenedesmus sp.*
    - Family Hydrodictyaceae
      - Genus *Pediastrum sp.*
    - Family Coccomyxaceae
      - Genus *Ourococcus sp.*
  - Order Ulotrichales
    - Family Ulotrichaceae
      - Genus *Binuclearia sp.*
      - Genus *Ulothrix sp.*

Family Microsporaceae
Genus *Microspora sp.*
Order Oedogoniales
Family Oedogoniaceae
Genus *Oedogonium sp.*
Order Zygnematales
Family Zygnemataceae
Genus *Spirogyra sp.*
Genus *Zygnema sp.*
Family Desmidiaceae
Genus. *Arthrodesmus sp.*
Genus *Cosmarium sp.*
Genus *Sphaerozosoma sp.*

II. Euglenas
Kingdom Plantae
Division Euglenophyta
Order Euglenales
Family Euglenaceae
Genus *Euglena sp.*

IV. Golden Algae
Kingdom Plantae
Division Chrysophyta
Order Mischococcales
Family Chlorobotrydaceae
Genus *Gloeobotrys sp.*
Family Sciadaceae
Genus *Centritractus sp.*
Order Tribonematales
Family Tribonemataceae
Genus *Tribonema sp.*
Order Ochromomadales
Family Dinobryaceae
Genus *Dinobryon sp.*
Family Ochromonadaceae
Genus *Uroglenopsis sp.*
Order Centrales
Family Coscinodiscaceae
Genus *Coscinodiscus sp.*
Genus *Cyclotella sp.*
Order Pennales

Family Fragilariaceae

Genus *Asterionella sp.*

Genus *Diatoma sp.*

Genus *Fragilaria sp.*

Genus *Synedra sp.*

Genus *Tabellaria sp.*

Family Surirellaceae

Genus Surirella sp.

Family Naviculaceae

Genus *Frustulia sp.*

Genus *Navicula sp.*

Family Cymbellaceae

Genus *Cymbella sp.*

Family Nitzschiaceae

Genus *Nitzschia sp.*

V. Bluegreen Algae

Kingdom Monera

Division Cynophyta

Order Oscilltoriales

Family Oscillatoriaceae

Genus *Oscillatoria sp.*

Genus *Lyngbya sp.*

Order Nostocales

Family Nostocaceae

Genus *Anabaena sp.*

Genus *Nostoc sp.*

Phytoplankton genera counted within the organic rearing ponds.

I. Green Algae

Kingdom Plante
Division Chlorophyta
Order Volvocales
Family Chlamydomonaceae
Genus *Chlamydomonas sp.*
Family Volvocaceae
Genus *Eudorina sp.*
Genus *Gonuim sp.*
Genus *Pleodorina sp.*
Genus *Volvox sp.*
Order Tetrasporales
Family Hypnomonadaceae
Genus *Sphaerocystis sp.*
Order Chlorococcales
Family Chlorococcaceae
Genus *Schroederia sp.*
Genus *Tetraheddron sp.*
Family Dictyosphaeriaceae
Genus *Dictyosphaerium sp.*
Genus *Dimorphococcus sp.*
Family Oocystaceae
Genus *Ankistrodesmus sp.*
Genus *Chlorella sp.*
Genus *Kirchneriella sp.*
Genus *Oocystis sp.*
Family Micractiniaceae
Genus *Micractinium sp.*
Family Scenedesmaceae
Genus *Actinastrum sp.*
Genus *Coelastrum sp.*
Genus *Scenedesmus sp.*
Family Hydrodictyaceae
Genus *Hydrodictyon sp.*
Genus *Pediastrum sp.*
Family Coccomyxaceae
Genus *Elaktothrix sp.*
Genus *Ourococcus sp.*

Order Ulotrichales
Family Ulotrichaceae
Genus *Ulothrix sp.*
Family Microsporaceae
Genus *Microspora sp.*
Order Ulvales
Family Prasiolaceae
Genus *Schizogonium sp.*
Order Zygnematales
Family Zygnemataceae
Genus *Spirogyra sp.*
Genus *Zygnema sp.*
Family Desmidiaceae
Genus. *Arthrodesmus sp.*
Genus *Closterium sp.*
Genus *Cosmarium sp.*
Genus *Euastrum sp.*
Genus *Sphaerozosoma sp.*
Family Mesotaeniaceae
Genus *Spirotaenia sp.*

III. Cryptomonads
Kingdom Plantae
Division Cryptophyta
Family Cryptochrysidaceae
Genus *Chroomonas sp.*
Genus *Rhodomonas sp.*

IV. Golden Algae
Kingdom Plantae
Division Chrysophyta
Order Mischococcales
Family Sciadaceae
Genus *Psudotetraedron sp.*
Order Tribonematales
Family Tribonemataceae
Genus *Tribonema sp.*
Order Ochromomadales
Family Dinobryaceae
Genus *Dinobryon sp.*
Family Ochromonadaceae
Genus *Uroglenopsis sp.*

Order Centrales
Family Coscinodiscaceae
Genus *Coscinodiscus sp.*
Genus *Cyclotella sp.*
Genus *Stephanodiscus sp.*
Order Pennales
Family Fragilariaceae
Genus *Asterionella sp.*
Genus *Diatoma sp.*
Genus *Fragilaria sp.*
Genus *Synedra sp.*
Genus *Tabellaria sp.*
Family Surirellaceae
Genus Surirella sp.
Family Naviculaceae
Genus *Frustulia sp.*
Genus *Navicula sp.*
Genus *Pinnularia sp.*
Genus *Staronesis sp.*
Family Cymbellaceae
Genus *Cymbella sp.*
Family Nitzschiaceae
Genus *Nitzschia sp.*

V. Bluegreen Algae
Kingdom Monera
Division Cynophyta
Order Chroococcales
Family Chroococcaceae
Genus *Anacystis sp.*
Genus *Gloeothece sp.*
Genus *Marssoniella sp.*
Order Oscilltoriales
Family Oscillatoriaceae
Genus *Lyngbya sp.*
Genus *Oscillatoria sp.*
Order Nostocales
Family Nostocaceae
Genus *Anabaena sp.*
Genus *Nostoc sp.*
Family Rivulariaceae

Genus *Calothrix sp.*
Genus *Rivularia sp.*

Appendix 7. List of Zooplankton genera counted within the rearing ponds during the 1997 growing season.

Appendix 7: Zooplankton genera counted within the inorganic rearing ponds.

I. Rotifers

Kingdom Animalia

Phylum Rotifera

Class Monogononta

Order Flosculariaceae

Family Filiniidae

Genus *Filinia sp.*

Family Testudinellidae

Genus *Testudinella sp.*

Family Trochosphaeridae

Genus *Trochosphaera sp.*

Order Ploima

Family Notommatidae

Genus *Cephalodella sp.*

Family Sychaetidae

Genus *Polyarthra sp.*

Genus *Synchaeta sp.*

Family Trichocercidae

Genus *Trichocercidae sp.*

Family Asplanchidae

Genus *Asplanchna sp.*

Genus *Asplanchnopus sp.*

Family Brachionidae

Genus *Bracionus sp.*

Genus *Keratella sp.*

Family Epiphanidae

Genus *Epiphanes sp.*

Family Lecanidae

Genus *Lecane sp.*

II. Crustaceans

Kingdom Animalia

Phylum Arthropoda

Class Branchiopoda

Order Cladocera

Family Bosminidae

Genus *Bosmina sp.*

Family Daphinidae

Genus Daphnia sp.

Family Leptodoridae

Genus *Leptodora sp.*

Class Ostracoda

Class Copepoda

Order

Family Cyclopidae

Genus Cyclops sp.

Zooplankton genera counted within the organic rearing ponds.

I. Rotifers

Kingdom Animalia
- Phylum Rotifera
  - Class Digononta
    - Order Bdelloidea
      - Family Philodinae
        - Genus *Philodina sp.*
  - Class Monogononta
    - Order Flosculariaceae
      - Family Filiniidae
        - Genus *Filinia sp.*
      - Family Trochosphaeridae
        - Genus *Trochosphaera sp.*
    - Order Ploima
      - Family Notommatidae
        - Genus *Cephalodella sp.*
      - Family Sychaetidae
        - Genus *Polyarthra sp.*
        - Genus *Synchaeta sp.*
      - Family Trichocercidae
        - Genus *Trichocercidae sp.*
      - Family Asplanchidae
        - Genus *Asplanchna sp.*
        - Genus *Asplanchnopus sp.*
      - Family Brachionidae
        - Genus *Bracionus sp.*
        - Genus *Keratella sp.*
        - Genus *Kellicottia sp.*
      - Family Epiphanidae
        - Genus *Epiphanes sp.*
      - Family Lecanidae
        - Genus *Lecane sp.*
      - Family Proalidae
        - Genus *Proales sp.*

II. Crustaceans

Kingdom Animalia

Phylum Arthropoda

Class Branchiopoda

Order Cladocera

Family Bosminidae

Genus *Bosmina sp.*

Genus *Eubosmina sp.*

Family Daphinidae

Genus *Daphnia sp.*

Family Leptodoridae

Genus *Leptodora sp.*

Family Macrothricidae

Genus *Macrothrix sp.*

Class Ostracoda

Class Copepoda

Order

Family Cyclopidae

Genus *Cyclops sp.*

Family Diaptomidae

Genus *Diaptomus sp.*